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Government-Owned Ships Opposed

By a vote of more than eight to one, over six hundred trade organizations in the United States have expressed their opposition to Government ownership and operation of steamship lines in the overseas trade. This vote was in response to a referendum submitted by the United States Chamber of Commerce to affiliated organizations throughout the country to determine the sentiment of business men relative to four proposed methods of aiding the American merchant marine. While the vote was eight to one in opposition to Government ownership and operation of merchant vessels, it was thirteen to one against Government ownership and private control. On the other hand, the question of subsidies from the Government to offset the difference in cost of operation of vessels under the American and under foreign flags was approved by a vote of three to one, while subventions from the Government to establish regular mail and freight steamship lines to countries in which the commercial interests of the United States are important and to American dependencies were approved by a vote of nearly fifteen to one. If this vote indicates nothing else, it shows that the business men of the United States are becoming alive to the importance of securing legislation for the upbuilding of the American merchant marine in the foreign trade. It is seldom that a referendum vote of this kind is called for by the National Chamber of Commerce, and to find that the sentiment of its constituents is utterly opposed to any form of Government ownership in marine transportation should give the present administration cause to carefully reconsider its policy in this direction.

Experience with Diesel Motors

After nearly three years' service as chief engineer of one of the earlier large Diesel-engined tank ships, a correspondent gives in this issue an account of the difficulties and troubles which he experienced in operating this type of machinery. That considerable trouble should be experienced with early installations of marine Diesel engines was to be expected. Reliable accounts, however, of just what such troubles consisted of, and how they were overcome, are seldom made public. In the instances cited by the engineer in this issue, the defects and breakdowns were by no means as serious as might be expected, and simple remedies were sufficient to entirely overcome them. Advances are continually being made in the perfection of details of such engines, and the successful designs of marine Diesel engines are fast winning a deserved reputation for reliability. We agree with our correspondent that Diesel motors for marine work will be greatly simplified in the future. As experience is gained, mistakes will be avoided and further development will proceed along sound lines.

Naval Reserve Urged

Better coast defenses, a definite military and naval policy, a budget system for appropriating money instead of the present "pork barrel" method, an effective *mobile* regular army, better Government support for the National Guard, and the creation of an organized army and navy reserve are among the platform planks upon which the recently organized Security League is sending out an appeal for public support. It is the present plan of the League to make national defense an issue at the coming session of Congress, and with this object in view branches of the League are being organized all over the country, especially in the districts of opposition. In so far as this appeal relates to the establishment of a naval reserve, naval officers and men in the merchant marine have long been fully aware of the necessity for such an organization. Recent laws enacted by Congress provide for a naval reserve composed of men who have served in the navy, but in addition to this there is an even greater need for a thoroughly organized naval reserve composed of the men in the merchant marine. The requirements of a naval auxiliary fleet are far greater than generally appreciated, both as to the number of men and the number of ships of various classes. To meet this need a naval reserve should include every able-bodied American seaman and officer.

Modern Submarines

Submarines of the United States Navy are of two general types, the Lake and the Holland. In this issue Mr. Simon Lake, the inventor of the Lake type, contributes the first installment of a remarkable series of articles on "Modern Submarines and Submarine Appliances in War and Peace." Beginning with a statement of the present position and impor-

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tance of the submarine, and the possibilities of its future development, a brief description is given of some of the early submarines, and the lessons learned from them which have been applied in modern development. In the following issues the author will take up modern submarines, explaining the principles of construction and operation, and giving a detailed description of the motive power for surface and submerged navigation and of auxiliary machinery and armament. The types of submarines in different navies will be compared and the vital question of their effect on the "control of the sea" will be discussed, as well as some speculations as to the future type of surface vessel to avoid the submarine peril, and as to the submarine's "answer."

While public attention for the last few months has been focused upon the operation of submarines in warfare, few have realized the splendid opportunities which await the development of submarine vessels in peaceful pursuits. That some of the early inventors of this type of vessel had in mind their possibilities for submarine exploration is evident from the ideas worked out in their design. The usefulness of the submarine is by no means limited to naval warfare, for, as suggested by Mr. Lake, underwater boats are feasible for transportation between ice-bound ports, hydrographic work, scientific investigations of sea coast bottom conditions, recovery of foodstuffs, wrecking and recovery of lost cargoes, dredging operations and the recovery of minerals, asphalts, fertilizers and the like, as well as for improving waterways, the construction of submarine tunnels, and for use in connection with the pearl, sponge and coral industries. The development of submarine boats and submarine appliances for such purposes will undoubtedly mark a new era in the progress of marine engineering.

"I Told You So!"

In our issue of November, 1913, we referred to the question of tolls in the Panama Canal as follows:

"It is not often that INTERNATIONAL MARINE ENGINEERING deviates from its text of engineering in the marine field, but the United States Government has so bungled the subject of tolls in the Panama Canal that we feel it a duty to protest. A thoroughly scientific manner of assessing tolls was presented to the Congressional Committee having the subject in charge and also to the President of the United States, but for some reason unknown to the public the old unreliable method of basing tolls on net tonnage was adopted. Net tonnage means little, if anything, depending upon the man who uses it. It is like figures which cannot lie as much as the man who uses them. Net tonnage works an injustice to some people and gives other people more than they are entitled to, especially if they wish to be tricky. Instead of simplifying the assessing of tolls it complicates it. The policy adopted by the Government opens the door to fraud upon the Government and the shipowner. Instead of being honest and perfectly fair to both sides, it deliberately drives shipbuilders and shipowners to subterfuge and petty trickery to get around the law. The action taken by the United States Government is a serious reflection upon American engineering ability and a great step backwards in these days of scientific attainments."

The authorities are already having a great deal of trouble in deciding upon what tolls to charge for deck loads of lumber and other loads that do not come under the general rules. While those officials who are responsible for assessing tolls are trying to decide upon what and how many exceptions shall be made to the general rules, shippers are complaining bitterly of excessive overcharging and threatening to appeal to the courts for protection. How simple it would have been to have adopted the block displacement system! Then there could not be any question as to how to assess tolls for deck loads of lumber or any other loads.

Pernicious Regulation

The Federal administration in Washington seems to have become obsessed with a desire to regulate everything. From our point of view it is not necessary to refer to the attempts that have been made to regulate various lines of business, or to the enormous expense these forms of regulation have caused the Government, but it does interest us to mention the attempt to regulate the merchant marine by the signing of the so-called Seamen's Bill. No outrage has been perpetrated on any struggling industry during the past half century that approaches this villainous bill. It has already caused the largest fleet of vessels flying the American flag in the overseas trade to haul down the flag, and undoubtedly other fleets will follow suit. With this horrible example before it, the adminstration now contemplates regulating motor boats, and a hearing regarding this proposed regulation was held in Washington on June 10.

The proposal was divided into three paragraphs. The first was to the effect that all small undocumented vessels navigated by machinery should be numbered and the name and address of the owner registered in the custom house. Few people realize that among the vessels of this type there are somewhere between 200,000 and 400,000 boats of 20 feet or under which are occasionally, or always, propelled by outboard motors. It is not unusual for a man to own a motor and hire a rowboat which at one time is a motor boat and perhaps an hour or so later may be a rowboat. To attempt to enforce a law of this kind will cost a very large amount of money. Furthermore, such a law cannot be enforced, as there will be thousands of motor boats run by people in regions a long distance from custom houses. Their owners would very likely not learn of the existence of such a law, or, if they did know of it, they would pay no attention to it.

The second paragraph related to the inspection of the hulls and the general condition of the engine of motor

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boats carrying twenty or more passengers for hire. To attempt to enforce this would cost the United States Government hundreds of thousands of dollars, and it would require many more inspectors than the Steamboat Inspection Service now employs to inspect steam vessels. No one knows how many motor boats would come under this classification, but there must be many thousands of them, as the report of the Commissioner of Navigation for 1905 estimated that 7,500,000 passengers were carried in these boats during the year. If such a law were enacted, it would work great injustice on thousands of these motor boat owners, especially upon the men who have no money to visit the nearest custom house, unless it is within a few hours' sail, and to whom the expense of making a long trip would be really prohibitive. These men would be compelled either to give up the little business upon which their livelihood depended, or to evade the law, if they happened to know that such a law was in force.

The third paragraph refers to these same boats for carrying passengers, and requires that all operators shall be licensed by the Steamboat Inspection Service as to their knowledge of the rules of the road, ability to distinguish colors, general knowledge of motors, and the navigation of waters in which the vessels are to be used. Such a law as this cannot possibly be enforced, and, even if it could be, it would work a great injustice to thousands of these motor boat owners. Suppose a man in some remote part of Maryland, or on some river in Texas, or in almost any one of the large States on the sea coast, is running a boat which comes under this classification. To compel him to make a trip, especially when it is a long one, to the nearest inspectors for the purpose of having the hull of his boat inspected, and to take an examination as to his ability to run his boat, would probably cost him more money than he could make out of his boat in an entire season. We doubt if this law could be even partially enforced at an expense of less than $500,000 (£102,500) a year. Add to this expense the cost of registering all motor boats at custom houses, and we feel confident that the Commissioner of Navigation will find that he is running into an expense pretty close up to $1,000,000 (£205,000) a year; and this at a time when we are paying war taxes and the government is finding it difficult to pay its present running expenses.

The main reason given for desiring to have these proposals enacted into law is because the motor boat act of 1910 cannot be enforced as it is at present worded. To quote from the statement:

"During last year in the harbor of New York, 607 violators of the law were discovered. Of the offenders in these cases, not less than 25 percent gave fictitious names and addresses."

In order to make it possible for the authorities to punish this 25 percent of the violators of the law, the government proposes to penalize 500,000 to 800,000 motor boat owners. Instead of spending this large amount of money and inflicting such injustice on motor boat owners, the law of 1910 should, if necessary, be changed to give authority to those who search for violators of the law to make arrests. If a man were to give a name that was supposed to be fictitious, and could not prove that he had given the correct name, it would be a very simple matter to seize his boat and tow it to the nearest custom house, or wherever such a violator of the law should be taken. The arrest of a few such individuals would do much more toward enforcing the law than the expenditure of a million dollars in an attempt to enforce a new law which in itself would be unjust and unenforceable.

We urge the authorities to make a greater effort to enforce the present law before putting more laws on the statute books. It is wholly unnecessary to penalize hundreds of thousands of innocent motor boat owners in an attempt to catch 152 lawbreakers. The enormous expense of the proposed undertaking is unwarranted. Most important of all, the government authorities should stop regulating things that do not need regulating.

The Second Largest Merchant Marine in the World

In a statement on page 237 of our issue for June we inadvertently referred to the American merchant marine as the third largest in the world. This is an unfortunate misstatement, as the American merchant marine had nearly twice the tonnage of the German merchant marine a year ago, and, with the destruction of German tonnage during the war, which will probably approximate 1,000,000 tons, the American merchant marine will shortly have more than twice the tonnage of the German merchant marine.

In his annual report for the fiscal year ending June 30, 1914, the Commissioner of Navigation states:

"On June 30, 1914, the merchant marine of the United States, including all kinds of documented ships, comprised 26,943 vessels of 7,928,688 gross tons."

In addition to the vessels documented by the Federal government, there are countless vessels aggregating thousands of tons plying exclusively in waters within State boundaries, and these are documented only under State authority.

The unfortunate statement in our June number was taken from figures quoted in Lloyd's Register of Shipping for 1914-1915, which gives the American merchant marine credit for only 3,174 vessels of a total tonnage of 5,368,194. The Bureau Veritas is even more negligent in reporting the tonnage of the American merchant marine, and the figures seem more inconsistent, as it gives us credit for 4,096 vessels of only 3,476,637 tons.

Since the report of the Commissioner of Navigation was issued, considerably over 500,000 tons of vessels have come under the American flag under the act of Congress of last August, and a very large tonnage will shortly be added to the merchant marine owing to the large number of vessels now under construction throughout the country.

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Modern Submarines in War and Peace

Present Status of the Submarine and Its Future Possibilities— Early Submarines and Lessons Applied to Modern Development

BY SIMON LAKE *

The submarine torpedo boat is just emerging from its swaddling clothes and beginning to speak for itself. Its progress and development have been retarded for many years by the lack of appreciation of its possibilities on the part of those who have had the planning of naval programs. Such men have been for the most part men of ripe years and experience, and perhaps because of these years of experience, they have become "ultra conservative" and have been inclined to "scoff" at or doubt the capabilities of any new device until it has been "tried out" by the "fire" of actual experience.

In studying the history of the development of the submarine, the author has been impressed by the showing made by Dr. David Bushnell, an American inventor and graduate of Yale in the class of 1775, who nearly sank the *Eagle* in New York harbor during the Revolutionary war by the use of his little one-man-powered submarine, the *American Turtle*. The author has also been impressed by the work of another American inventor, Robert Fulton, the man who made the steamboat a success. In England in the presence of William Pitt, then chancellor, and a large number of spectators, Fulton blew up a brig by exploding a mine which he had placed under her bottom by the use of his submarine boat. Both of these inventors were discouraged and were refused the necessary assistance to enable them to further develop their ideas regarding submarines, although they had undoubtedly shown that there were great possibilities in the underwater type of vessel.

The author believes that it is the lack of imagination on the part of the average successful business or professional man that makes him unable to recognize the possibilities of new devices until they have been tried out in practice. It needs an imagination to become an inventor or creator of new things. Notwithstanding the fact that the problem of submarine navigation has been successfully solved for the past fifteen years, it has only been within the past two years that any great naval authority has unqualifiedly endorsed submarines as being of paramount importance in naval affairs.

Admiral Sir Percy Scott, in a "strong" letter to the London *Times* a short time previous to the beginning of the present war, stated:

"The introduction of the vessels that swim under water has, in my opinion, entirely done away with the utility of the ships that swim on top of the water."

He stated further: "If we go to war with a country that is within striking distance of submarines, I am of the opinion that that country will at once lock up their dreadnoughts in some safe harbor and we shall do the same. . . .

"I do not think the importance of submarines has been fully recognized, neither do I think that it has been realized how completely their advent has revolutionized naval warfare. In my opinion, as the motor which has driven the horse from the road, so has the submarine driven the battleship from the sea."

Sir Percy Scott is, however, himself an inventor, and of course must have an "imagination" because he is the man who invented the "spot" method of gun firing which has enabled gunners to increase their efficiency several *thousand percent* in making hits.

Sir Conan Doyle, the celebrated novelist, had sufficient imagination to prophesy with such accuracy as to make his story seem almost "uncanny" as to what is actually taking place now around the coast of England in the carrying out of Germany's "submarine blockade." Mr. R. H. M. Robinson, a former United States naval constructor, who has had charge of the design of all of the United States dreadnoughts and the latest destroyers, recently stated in an article in *Harper's Weekly*, in reference to the possibility of protecting the underwater body of a ship from torpedo attack: "Several propositions have

* Member of Institution of Naval Architects (England), Schiffbautechnische Gesellschaft (Germany), Society of Naval Architects and Marine Engineers (United States) and American Society of Mechanical Engineers.

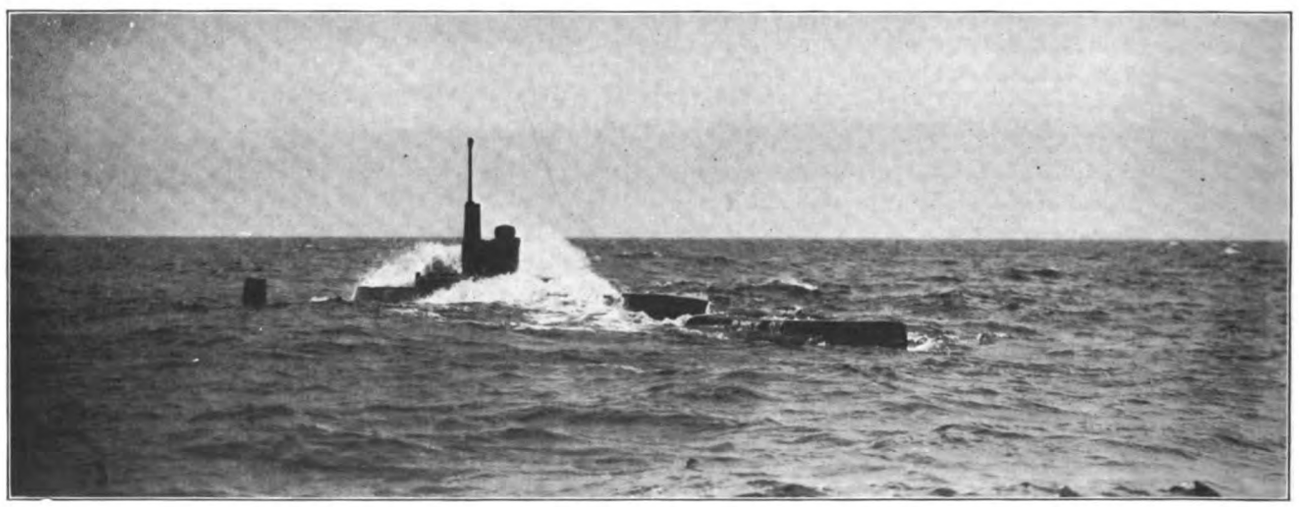

Fig. 1.—Russian Submarine *Kaiman* Making a Surface Run in the Gulf of Finland

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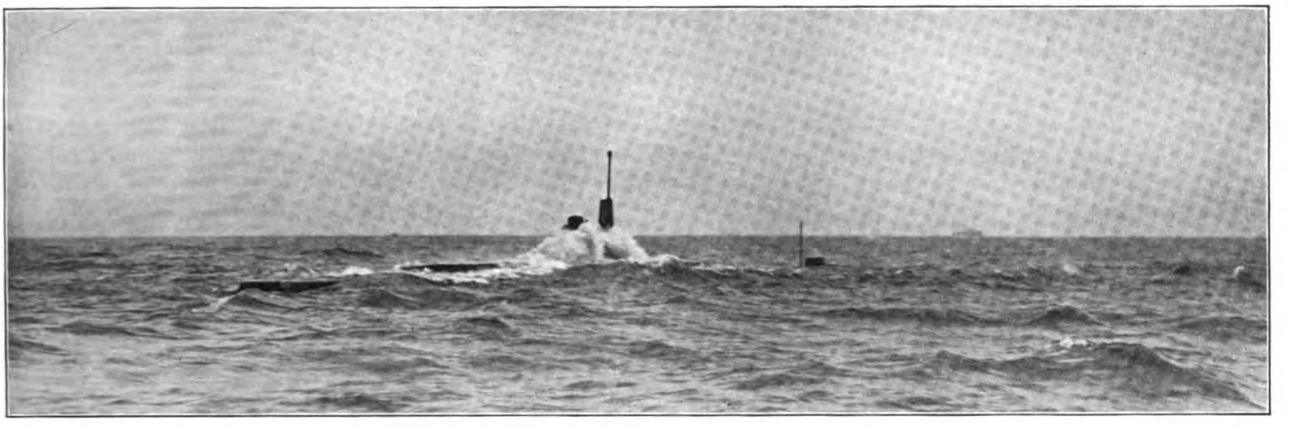

Fig. 2.—The *Kaiman* Submerging in Rough Weather

been advanced as to protecting the underwater part of the hull against torpedo damage. A favorite proposition is underwater armor. You can take it from me that such a proposition of underwater armor, at least externally applied, is absolutely futile."

Experiments have shown that a mine of sufficient power properly placed under a ship will exert sufficient force to break her in two. The force of an explosion goes in the direction of least resistance, and owing to the fact that water is practically incompressible, the line of least resistance is always upwards. Assume that it *were possible* to build a floating structure of sufficient strength to resist rupture of its plates, in that case the entire structure would probably be blown bodily out of the water.

The inventors of submarines, therefore, in the light of the opinion of high authorities and of what is happening, are justified and may perhaps be pardoned if they say, "I told you so."

INTERNATIONAL MARINE ENGINEERING has asked the writer to tell something more about the future possibilities of the submarine boat and has expressed the opinion that "now that they have made good" those interested in shipping will be able to "see" with the "seeing eye" other possibilities of the submarine, if their attention is called to them. In preparing these articles, therefore, I may make claims for submarines that have not yet been publicly proved by actual performance, and such claims may, therefore, appear to many to be as visionary as the capabilities of submarines appeared to be until within the last few months Lieutenant Weddigen of the German navy shocked the conservatives and put the submarine in its proper place by sinking, single-handed, three cruisers within one hour of each other. I shall be careful, however, not to make any claim for submarines that is not warranted from experiments actually made or from calculations based upon experiments actually made during the author's twenty-two years' continual study and experience in designing and building submarine boats and submarine appliances in the United States and abroad.

FUTURE POSSIBILITIES OF THE SUBMARINE

My study of the capabilities of submarines has led me to believe that these vessels have a greater destiny, in that they will be the means of bringing about a permanent peace between maritime nations. I do not believe that one country can invade another country by sea where submarines exist. Neither do I believe that when the submarine reaches its full development any maritime country can carry on its commerce with other countries with surface ships on the high seas as long as it is in a state of war with any one country that possesses submarines.

I believe that if the present war lasts two years longer the warring nations will have sufficient submarines in commission to demonstrate the submarines' capabilities as "peace promoters" and that there will never be another great war between maritime nations. These statements may seem "too good to be true," but the author is not alone among inventors in taking this view of the wonderful possibilities of the submarine in this respect. Robert Fulton's letter referring to his experiments in submarine warfare, said: "All my reflections have led me to believe that this application of it (the use of the mines placed by submarines) will in a few years put a stop to maritime wars, give that liberty on the seas which has been long and anxiously desired by every good man, and secure to Americans that liberty which will enable citizens to apply their mental and corporeal faculties to useful and humane pursuits, to the improvement of our country and the happiness of the whole people."

Mr. John P. Holland years ago called attention to the important fact that "submarines cannot fight submarines." This is a true statement simply because they cannot see or locate each other when submerged. It is impossible to fight with an unseen opponent under the seas.

The submarine is unique in that it is the first weapon that does not become obsolete by building a superior weapon of the same type. The contest between speed of ship and range of guns and between guns and armor has been going on ever since the gun was invented. Size and speed of ship and range of gun, and speed of projectile, have been constantly increased so that the latest ship will be able to stand off at a distance out of range of the earlier ships armed with guns built, perhaps, only a year or so before, and deliberately destroy the earlier ship without danger to herself. This early decay does not apply to the submarine for defensive purposes. Any submarine vessel that is capable of being maneuvered under water and is fitted to carry and fire Whitehead torpedoes or to plant a mine is an exceedingly dangerous craft to surface ships no matter how large or powerful such surface ships may be. The present war has shown that a Whitehead torpedo exploded beneath a battleship will cause that battleship to founder in a few minutes.

Naval architects and engineers the world over have been trying to find some means of protecting the battleship. I shall tell of these efforts in a later article, but I believe that it will never be possible to protect the heavy armored battleship from submarine attack. If surface warships are to survive they must be of an entirely new type.

The present relation of the submarine and surface vessel may be summed up as follows:

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The submarine has shown its superiority over any type of surface vessel when within torpedo range.

The surface vessel has shown its superiority only in its ability to "run away" from the submarine, and in the fact that it is equipped with more reliable machinery.

The submarine has, during the present war, already forced the abandonment of the close blockade and forced the fleets of the largest and most powerful maritime nations to seek refuge behind mine-protected bases or else to keep constantly under way on the high seas, when in localities known to be frequented by sumbarines. It is one of the objects of the author to show how the present handicap of mine protection and superior speed in favor of the surface vessel may be overcome by the submarine of the future.

To understand the great possibilities of the future submarine it is necessary to study briefly the principles of the submarine's past development, so as to apply the lessons to our future designs, if these boats are to take the place they are rightly entitled to as the *mainstay of our national defense system.*

Only a few of the many experimental submarines that were built previous to the beginning of the present century taught lessons of value, because the great majority of them were total failures. However, the cause of their failures is important, because it teaches us what to avoid. Practically all the early submarines were built secretly, and if failure resulted the vessel was abandoned and the results of such trials were not published, consequently the next designer was very apt to make the same mistakes.

It was not until within the past decade that any general description of many of the early submarines was published and made available to students of the problem. The writer has been impressed in looking over the published plans and descriptions of many of the early submarines that many lives and much capital could have been saved had the results of the various experiments been published.

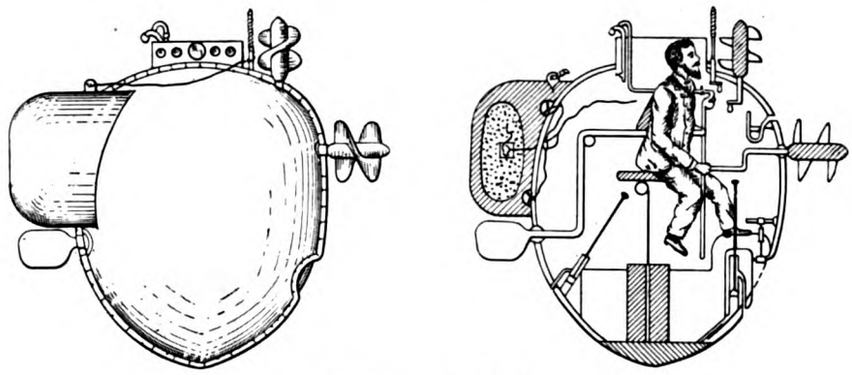

Fig. 3.—Bushnell's Submarine, *The American Turtle*

The desire to navigate in the depths of the sea has possessed the minds of many men since the beginning of history, and several crude submarines had been devised in the attempt to solve the problem. However, it was not until the period of the war between England and her American colonists that any important progress was made.

Bushnell's little submarine, called the *American Turtle*, was built at that time. It took its name from its shape, which resembled the back shells of two turtles joined together. From the rather complete description of this vessel contained in one of Dr. Bushnell's letters, it has

Fig. 4.—British Submarine B 1 (Holland Type), a Sister Ship to B 11, That Recently Sank the Turkish Battleship *Messudieh* in the Dardanelles. These Vessels Are Practically the Same as the C Type in the United States Navy

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been found that this vessel was propelled by a screw propeller to obtain forward or reverse motion. It was ballasted in such a manner as to give the vessel great inherent stability. It had water ballast tanks which could be filled to give the vessel negative buoyancy, if desired, or to reduce the positive buoyancy so that the vessel could be readily drawn under water by another screw propeller which was operated by a vertical shaft extending through a stuffing box into the vessel. This submarine carried a mine on its back and provision was made from the interior of the vessel to attach the mine to the bottom of a ship at anchor so that the mine could be exploded by clockwork mechanism after the submarine had reached a safe distance away from the vessel.

EXPLOIT OF THE AMERICAN TURTLE

With this vessel, a mine was placed under the bottom of the English frigate *Eagle* anchored in New York bay, but it drifted clear before the clockwork mechanism caused it to explode, otherwise the ship undoubtedly would have been destroyed. General Washington complimented Dr. Bushnell on having so nearly succeeded in his attempt to sink the ship.

This submarine was undoubtedly a successful model. It had one important feature many designers have failed

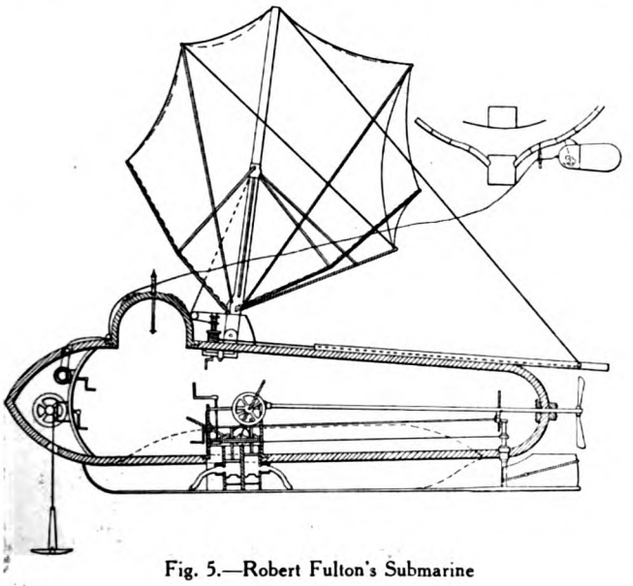

Fig. 5.—Robert Fulton's Submarine

to appreciate, and that was great inherent stability. Great stability in a submarine means the carrying out of the now popular maxim "Safety First." Sufficient static stability is a guarantee that during all the maneuvering evolutions of a submarine she will always remain right side up and not dive into the bottom unless the hull is punctured or flooded at one end or the other.

Bushnell's model was not suited to high speed, but high speed was not essential in the days of the sailing ship. If this model had been developed further so that several men could have been used to operate the propeller, it should have given a good account of itself.

Robert Fulton's boat differed from Bushnell's in its method of submerged control, which was by vertical and horizontal rudders at the stern. It also carried a collapsible mast on which a sail could be spread for surface navigation.

A Bavarian by the name of Bauer built a submarine in 1850. Its method of control was by shifting a weight forward to dive and aft to rise. It was a flat-sided and flat-decked vessel with comparatively thin plating and entirely unsuited to resist the pressure of the water at any considerable depth. It collapsed in the harbor of Kiel during one of its trial trips. Bauer kept his presence of mind, however, and when sufficient water had entered and raised the trapped air pressure inside of the boat equal

Fig. 6.—Germany's First Submarine; Built by Bauer, But Lost in Kiel Roads in 1851; Located and Recovered in 1887

to the pressure outside he opened the hatch and swam to the surface. This vessel remained partly buried in the mud where it collapsed until 1887, when it was located during the deepening of Kiel harbor and taken to Berlin, where it is now kept in the Museum of Oceanography as an exhibit of Germany's first submarine.

No further important advance was made in the art of submarine navigation until the period of the Civil War, when the Confederates built several small submarines

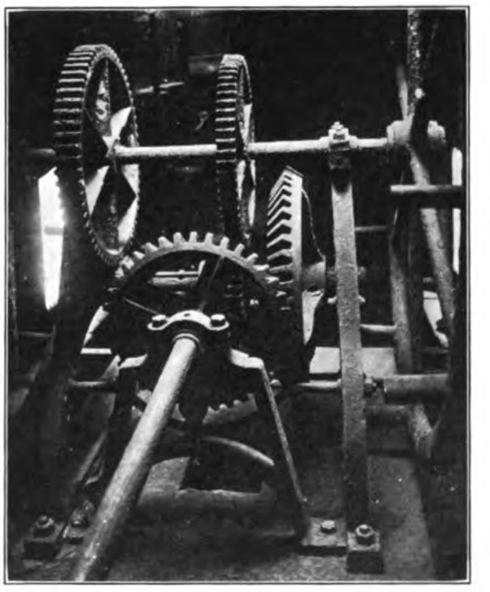

Fig. 7.—Interior View of the First German Submarine, Showing Mechanism

called *Davids*. One of these was called the *Hunley* after her designer. During her brief career she suffocated or drowned thirty-two men, including her designer.

The author, during his early experiments with the *Argonaut* in 1898, received a visit from Colonel Charles H. Hasker, of Richmond, Va., who explained in detail the method of operating the *Hunley*. She was a cylin-

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drical shaped craft about 30 feet long and 6 feet in diameter, with both bow and stern flattened to form a stem and sternpost, respectively. Water ballast compartments were located in either end of the vessel. She was propelled by eight men, who turned the cranked propeller shaft by hand. These men sat on benches on either side of the shaft. She had the usual vertically hung rudder aft, and a diving rudder forward to incline her bow down

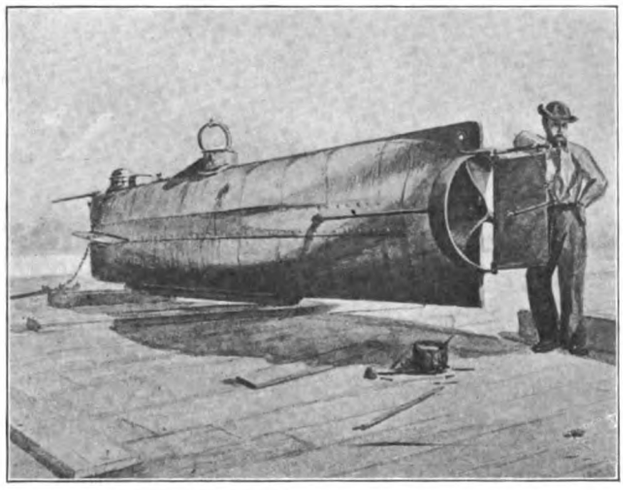

Fig. 8.—Sketch of the Confederate Submarine *Hunley*

for diving, or to raise her bow to bring her to the surface. However, she lacked longitudinal stability, and during her experimental trials twice dove head first into the bottom. She was located and recovered each time too late to save her crew, who had been thrown to the forward part of their operating compartment, where they died from suffocation, because they could not pump the vessel out when she stood on end.

FATAL TRIAL OF THE HUNLEY

Notwithstanding these disheartening disasters, another crew volunteered to try her again, and Colonel Hasker, who was a lieutenant in the Confederate service, volunteered as one of the crew. He stated that when the crew was made up they started out for a trial under the command of Lieutenant Payne. On this trial she was trimmed down at the dock so that she possessed very little reserve of buoyancy, and while in this condition the gunboat *Ettawan* was asked to tow them out into the stream. As soon as the submarine gained headway she started to "sheer." Lieutenant Payne attempted to throw the "bight" of the towing line off the hatch combing over which it had been placed to tow her. He became entangled in the line, and in his struggle to free himself his foot struck a prop placed under the diving rudder tiller, which threw the rudder into the diving position. She plunged head first to the bottom. Lieutenant Payne and Mr. Hasker escaped out of the forward hatch and two others escaped out of the after hatch. The other five members of the crew were drowned.

The *Hunley* was raised again and fitted with a spare torpedo. On the night of February 17, 1864, Lieutenant Dixon succeeded in approaching, in an awash condition, the U. S. S. *Housatonic,* and sank her by exploding a torpedo under her bottom. The wave thrown up by the explosion swamped the submarine (because her forward hatch was open) and again carried the submarine and her brave crew to the bottom, making a total of thirty-two men lost on this submarine, which, however, sank the first man-of-war in actual warfare. The *Housatonic* was a fine new ship of 1,400 tons displacement.

The lesson to be learned from the disastrous trials of this vessel was that sufficient statical stability should always be secured to prevent the vessel taking on an excessive inclination due to shifting of water ballast or movement of crew.

Another submarine built by the Confederates shows a much safer design. It is shown in Fig. 9 as the New Orleans submarine. According to the story told by a native of New Orleans this vessel was built during the Civil War to destroy the Northern ships. When the vessel was completed the designer thought it would be a fine performance to have the vessel plunge under water as she left the ways and make a short trip before coming to the surface. Accordingly, he instructed two of his most intelligent slaves how to operate the vessel when submerged. A large crowd assembled to witness the vessel's launching.

LAUNCH OF THE NEW ORLEANS SUBMARINE

When they were ready to launch, the two negroes entered the submarine and closed the hatch cover. She was launched with good speed and disappeared according to program, but did not reappear. Although search was made for the vessel with sweep lines and grappling hooks, she could not be found. What became of her remained a mystery for many years until, during dredging operations, many years afterwards, she was located half buried in the mud at the bottom of the harbor, and was raised. On opening the hatch the skeletons of the two slaves were found within.

It is evident the designer miscalculated and made his boat so much overweight that she could not be given sufficient buoyancy by the means provided to bring her to the surface. From a study of the form of this vessel, she

Fig. 9.—The New Orleans Submarine

should have been very stable, and I am of the opinion that she could have been successfully navigated submerged had she been properly ballasted.

During the years 1863 and 1864, Messrs. Bourgois and Brun brought out for the French nayy the largest and in some respects the most completely equipped submarine that was produced during the nineteenth century. This was *Le Plongeur,* a vessel about 140 feet long, 10 feet depth and 20 feet beam, with a displacement of over 400 tons. Her motive power was compressed air engines of 80 horsepower. The compressed air was carried in air tanks at a pressure of 180 pounds per square inch. It is reported that the capacity of the air tanks exceeded 140 cubic meters.

Her submerged control system consisted of the usual

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water ballast tanks for reducing the vessel's surface buoyancy preparatory to submerging. The final adjustment of displacement was to be effected by means of cylinders which could be forced out through stuffing boxes to increase her displacement or withdrawn to reduce her displacement. It was hoped that by manipulating these cylinders she could be put in equilibrium with the water she displaced and that she could then be steered in any desired direction by the vertical and horizontal rudders placed at her stern.

Theoretically this is an ideal method for submerged control, but in practice it works out badly, especially when a vessel has little stability, for the reason that there are so many disturbing influences to cause the vessel to take on dangerous angles in "diving." If "free surfaces" exist in the water ballast tanks, the slightest change from a level keel causes the water to flow to the lower end of the ballast tank. This is apt to augment still further the inclination and cause the vessel to "dive" or, vice versa, to "broach." The density of the water also varies, especially where fresh water rivers empty into salt water. At times quite different densities are found at various depths. The fresh water and salt water, instead of rapidly "mixing," seem to have a tendency to remain in "strata" which extend, in some cases, considerable distances off shore. Therefore it is practically impossible to secure and maintain a vessel in perfect equilibrium. The movement of the crew forward and aft, or the effect of the sea, which imparts a vertical motion to the water beneath the surface, all tend to destroy both trim and equilibrium to such an extent that many failures resulted in vessels of this type.

Le Plongeur was no exception to this rule, because it was found impossible to conrol her depth when running submerged, and she would either "dive" into the bottom or "broach" to the surface. One report stated that even in depths of 30 feet she would make progress "by alternately striking the bottom and then rebound to the surface like an elastic india rubber ball."

One other novel feature introduced in *Le Plongeur* was an "escape boat," which was carried on top of the main hull, to which it was secured by bolts. A double hatch connected the submarine and the "escape boat" together. In case the submarine became disabled or entangled in wreckage and could not be brought to the surface, the crew could enter through double hatches into the escape boat, secure the bottom hatch and by turning the securing bolts from the interior release the escape boat and ascend to the surface.

Mr. O. S. Halstead, of Newark, N. J., completed in

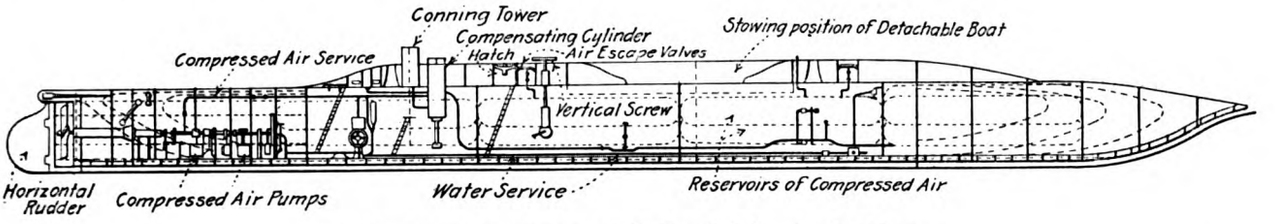

Fig. 10.—Longitudinal Section of the French Submarine *Le Plongeur*

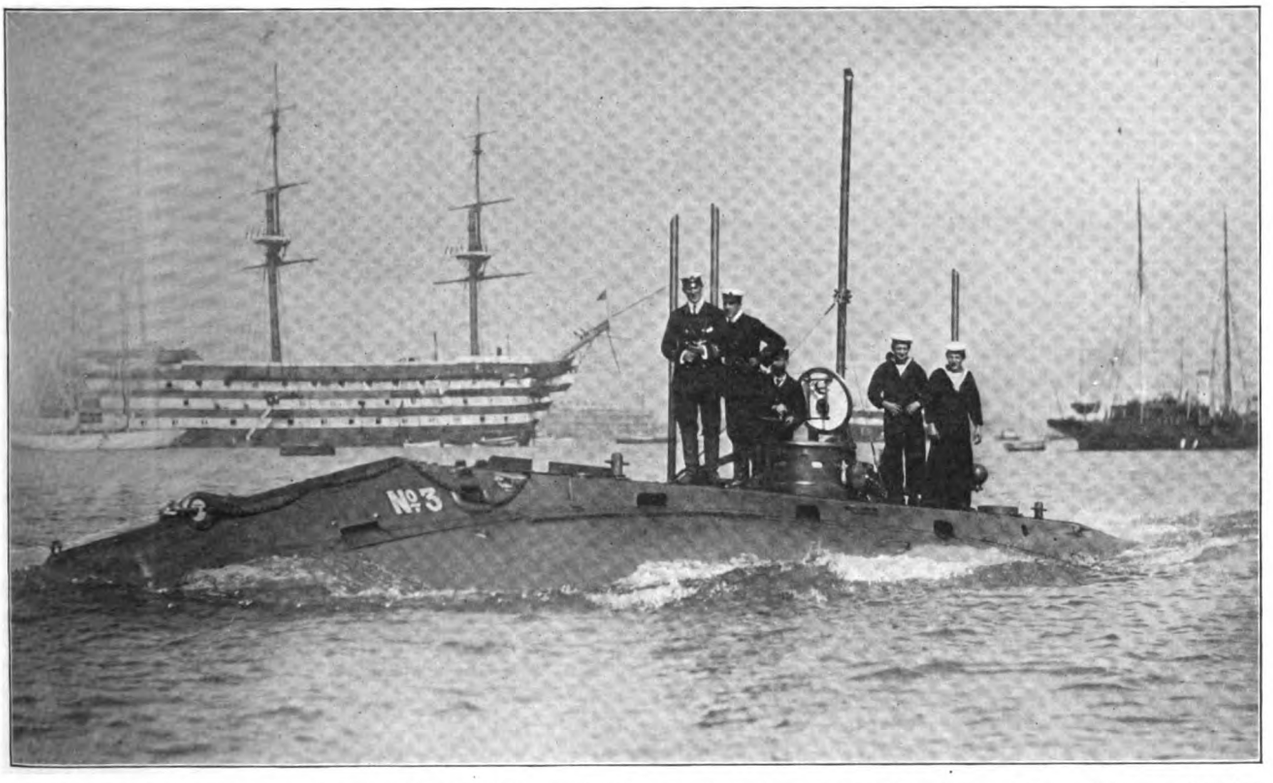

Fig. 11.—British Submarine No. 3 Passing Nelson's Old Flagship *Victory*. This Submarine is of the Holland Type, Similar to the U. S. *Adder* and *Moccasin*

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1866 a submarine vessel, on which the U. S. Government made partial payment. This vessel is known as the *Intelligent Whale*, and is now installed, as a permanent exhibit, on the Green at the Brooklyn Navy Yard, New York. The vessel had a vertical and horizontal rudder at the stern for submerged control. According to

The contract specified certain conditions to be fulfilled before the final payment was to have been made, one of which was that Halstead should "write out fully and describe, without reservation, all the inventions, secrets and contrivances necessary to enable any competent person or persons to operate and manage said boat as contemplated,

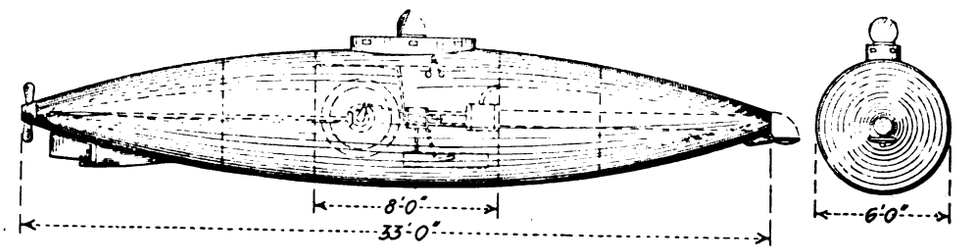

Fig. 12.—*Fenian Ram*, the First Holland Submarine Boat (1877). Sketch Made by Simon Lake After Measuring the Boat at New Haven, Conn.

official reports she must have functioned fairly well when submerged.

One of the features of this vessel consisted in its ability to be converted into a diving bell when resting on the bottom. A large trap door was arranged in the bottom of the vessel. After filling the whole interior of the vessel with compressed air equal in pressure to the pressure of the water at the bottom of the vessel, the trap door could be opened and the air pressure would keep the water from rising, the same as in a diving bell.

A study of this vessel shows that she must have been a very stable craft and not likely to "dive" at an excessive angle or to "stand on end," as was the tendency of many of the early diving boats. A report signed by General

desired or designed, more especially the methods of furnishing, managing, controlling, purifying and renewing the air when and in quantity as needed, so as to enable those in the boat to descend and ascend or remain under water any reasonable length of time. Also to open the doors in the bottom of the boat and keep the water from coming therein at any reasonable and regulated depth." For this information Halstead was to receive such further sum as a board of officers might grant. Halstead was to have the further right to apply to Congress for additional compensation.

In carrying out the provisions of the contract, the Government on May 27, 1870, took over the *Intelligent Whale* and then paid $12,050 (£2,470) on account of the contract.

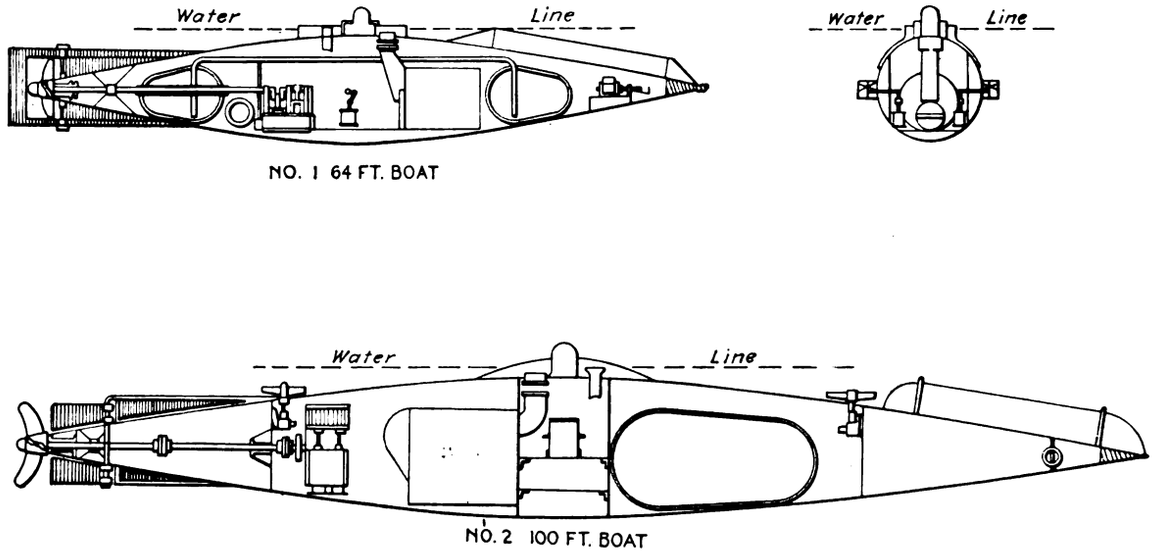

Fig. 13.—Nordenfelt Submarine Boats

T. W. Sweeny, U. S. Army, and Colonel John Michal, Colonel T. R. Tresilian and Major R. C. Bocking, engineers, strongly endorsed this vessel.

On the strength of the above-mentioned reports and endorsements, the Government through the Navy Department appointed a commission composed of Commodore C. M. Smith, Commodore Augustus L. Chase, Chief of Bureau of Ordnance, and Edward O. Mathews, Chief of the Torpedo Board, "to examine, inspect and report on the merits of said boat." As the report of this commission confirmed the capacity and efficiency of the boat for submarine purposes, the Government made a contract for her purchase for the sum of $50,000 (£10,250).

Shortly after this Halstead was instantly killed. Differences then arose between Halstead's heirs and others who claimed an interest in the contract. It does not appear that anything further was ever done with the boat to carry out the terms of the contract. She lay neglected for many years on the old "Cob dock" in the Brooklyn Navy Yard, but has recently been erected as an exhibit on the "Green."

Mr. J. P. Holland brought out, in 1876, a submarine vessel called the *Fenian Ram*. This vessel was about 30 feet long and 6 feet in diameter. She was navigated when submerged by the use of vertical and horizontal rudders located at the stern. The novel feature introduced

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in the vessel was an underwater air gun which was designed to fire a shell under water.

Mr. Holland was a school teacher in Ireland, from which country he was exiled because of his political beliefs. On coming to the United States he became affiliated with the Fenian movement. The money to build the

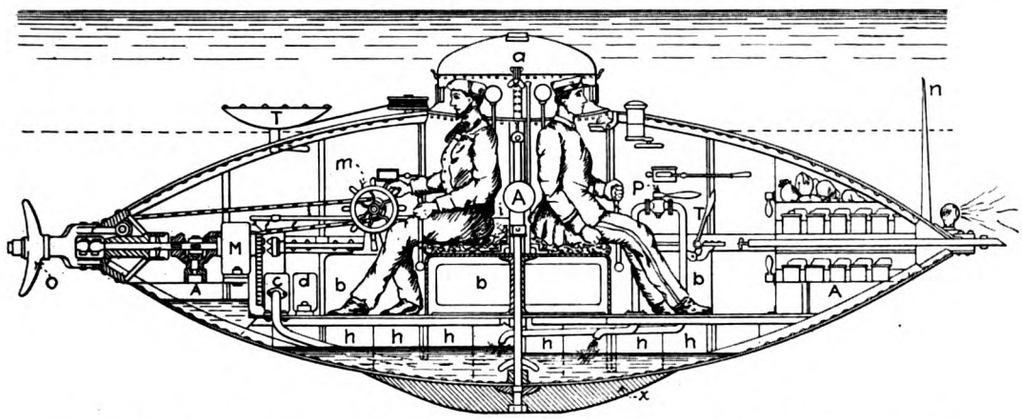

Fig. 14.—Longitudinal Section of *Goubet I*. *A*—Trimming Tank System. *a*—Conning Tower. *b*—Compressed Air Reservoirs. *c d*—Pumps. *h h*—Water Ballast Tanks. *i*—Electric Accumulators. *m*—Wheel for Moving Propeller to Port or Starboard. *M*—Electric Motor. *P*—Water Ballast Control. *T*—Torpedo. *O*—Propeller. *X*—Safety Weight. *n*—Submerging Batten.

Fenian Ram was subscribed by the "Clan na Gael" and other Irish patriotic societies. An associate of Mr. Holland recently informed the writer that over $200,000 (£41,000) was subscribed to enable Mr. Holland to carry on his experiments.

Previous to his construction of the *Fenian Ram*, Mr. Holland built a small one-man boat. After the collapse of the Fenian movement the *Fenian Ram* was towed up to New Haven, Conn., and hauled out on the banks of the river, where it has lain ever since, hidden under a pile of lumber.

Still one of the former leaders of the Fenians recently informed the author that the scheme was to build a number of submarines of about the size of the *Ram*. They were to have been carried across the Atlantic in a special ship with watertight compartments extending below the waterline, into which the submarines were to have been floated and a sea door closed. On arrival on the English coast, this special ship, which was apparently a harmless merchantman, was to locate the British war vessels in some of the harbors, sail in and anchor near them, then the little submarines would be released from their "mother ship" and proceed to sink as many of the British ships as they could by firing explosive shells into them below the waterline. The novelty of such an attack was relied upon to spread consternation among the British fleet and enable the submarines to escape.

In 1878 Mr. G. W. Garrett, of Liverpool, took out a patent and brought out a small boat whose equilibrium was to have been maintained by the admission of water into a cylinder and forcing it out by a piston. In 1879 Mr. Garrett brought out a larger vessel called the *Resurgam* in which his means of control were forward diving rudders similar to those of the Confederate *Hunley*. The novel feature of this vessel was the installation of a very large steam boiler in which sufficient heat could be stored to continue to give off steam to enable the vessel to make a submerged run of several miles after the fires were shut

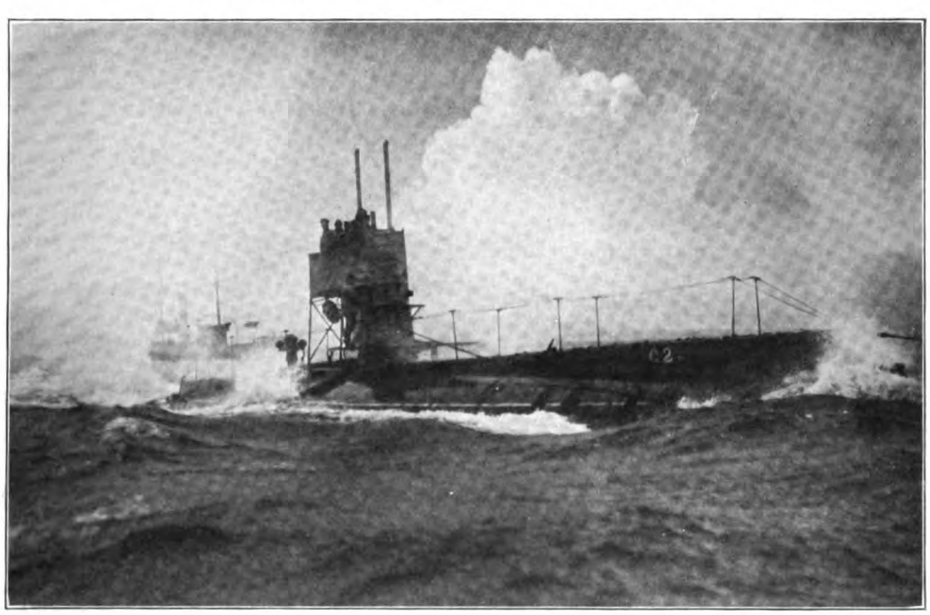

Fig. 15.—British Submarine C 2 Arriving at Portsmouth in a Gale. Note Hydroplanes at Center of Conning Tower: in Later Types These Were Placed Under the Water

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down. This vessel was lost during her experimental trials.

Mr. Garrett then interested Mr. Nordenfelt, the inventor of the celebrated Nordenfelt gun, in his boat. Mr. Nordenfelt improved upon Garrett's boat and built vessels for Greece, Turkey and Russia. His first boat was 64 feet in length by 9 feet beam, with a displacement of about 60 tons. His means of submerged control was by the use of two downhaul screws located in sponsons on either side of the vessel. These screws were operated by bevel gears and were run at sufficient speed to overcome the reserve of buoyancy. The vessel was intended to be always operated with a reserve of buoyancy. Therefore, to submerge it was necessary to run the propellers at a speed sufficient to exert a thrust to overcome this buoyancy and pull her bodily under water. After reaching the desired depth, forward motion was then to be given by the usual screw propeller and she was expected to make progress on a level keel and in a horizontal plane. The level keel was to have been maintained by the use of a horizontal rudder placed in the bow.

This method of submerged control seems to me to be an excellent one in principle for moderate speed submarine vessels. I have been surprised that further development was not made along these lines. I think the final abandonment of the Nordenfelt type of vessel was due to failure in carrying out the details of design rather than to faulty principle. A former chief engineer of Mr. Nordenfelt informed me that the heat from the large amount of hot water stored up in the reservoirs (for submerged power) made it almost unbearable for the crew when the hatches were shut down, and that he did not believe the submarines ever made any submerged runs after being delivered. I also judge from his description of his experiences in the vessels that they lacked longitudinal stability and were difficult to be kept in the horizontal position which Mr. Nordenfelt claimed was a "sine qua non" for a submarine boat. I concur in this claim.

In an article on his boats Mr. Nordenfelt stated they were very sensitive, and that he purposely made them so in order that the horizontal rudder would easily maintain the boat in a horizontal position. My experience has led me to prefer great statical stability rather than sensitiveness.

Mr. Nordenfelt's boats had means for discharging, under water, the smoke from the fires so as not to betray the sumbarine's position to surface vessels. He also seems to have been the first to incorporate within his hull torpedo tubes for the discharge of the Whitehead torpedo.

Lieutenant Isaac Peral built in 1887 a vessel in which the motive power was supplied from electric accumulators. It was operated by the usual vertical and horizontal rudders. Its submerged control was bad, but its electric propulsive system worked well.

Mr. Goubet built several small boats in 1885 to 1890 with a propeller which worked on a universal joint so arranged that the direction of thrust could be changed to drive the boat under water or to bring her to the surface. This propeller took the place of the usual vertical and horizontal rudders.

Professor Josiah L. Tuck built in 1885 a vessel called the *Peacemaker*, the novel feature of which consisted of a "caustic soda" boiler for generating steam for submerged work.

In 1886 a Mr. Waddington, of England, brought out a small electric accumulator boat with downhaul screws arranged in vertical tubes. He also used side rudders to assist in control of depth. It is reported that this vessel functioned quite successfully, but she was abandoned and Mr. Waddington does not seem to have developed anything further.

In 1882 George H. Baker brought out an egg-shaped vessel which he ran submerged by the use of side propellers driven by bevel gears. These propellers were carried in frames so that they could be inclined to exert a thrust downward or upward, or at any desired angle so as to pull the boat downward and drive her forward at the same time. This was an improvement over Nordenfelt's side propellers, which ran on fixed vertical shafts. This vessel functioned fairly satisfactorily at slow speeds, but neither the form nor driving mechanism was suitable for the higher speeds required by modern practice.

A number of other boats were built, but there does not appear in them to be anything new in principle. This brings us up to 1893, when the United States Government made an appropriation of $200,000 (£41,000) for a submarine boat and advertised for inventors to submit designs.

(*To be continued.*)

The Largest Hopper Bucket Dredger

The largest of three somewhat similar dregders which Messrs. Lobnitz & Co., Ltd., of Renfrew, Scotland, have supplied to the Suez Canal Company for service in the Port Said roads, where the working situation is very exposed and the dredging hard and difficult, is the *Penelope*, a vessel with a length of 309 feet, a breadth of 47 feet, and a depth of 29 feet 2 inches. The dredging machinery is of the most approved type, and there is an independent engine direct geared to the top tumbler. The twin screw propelling machinery is independent. All the gearing has machine-cut teeth. The bucket ladder is fitted with patent elastic gear for facilitating dredging in hard ground in a seaway.

An interesting feature of the equipment is the adoption of a Lobnitz lubricated bottom tumbler, a device first fitted to the North Eastern Railway Company's dredger *David Dale*, now in service at Hull. The *David Dale* has still her original bottom tumbler shaft in use after eight years' hard work, and we understand that the wear is so little that the shaft is still as serviceable as when new. Without this device the *David Dale* would have required more than a dozen new shafts, so that the saving on such a large machine, in time and in outlay for repairs, is very great. The same device has since been fitted by the North Eastern Railway Company to several of their dredgers, and it has also been adopted on the Panama Canal, by the Clyde Trust, and elsewhere.

The hopper door gear and shoots of the *Penelope* are worked by hydraulic pressure, all the doors being independent.

COMMERCE THROUGH THE SOO CANALS.—According to reports of the United States engineer in charge of the United States canal at Sault Ste. Marie, Mich., the number of passages both east and west bound through the American canal since its opening on April 17 up to May 31 was 2,336, and the net registered tonnage 6,446,872, as against 1,772 passages and 3,555,756 tons for the same period a year ago. For the Canadian canal the figures for 1915 were 659 passages and 833,219 tons, as against 918 passages and 2,791,675 tons for the corresponding period in 1914. In 1914, however, both canals opened on April 20, while in 1915 the United States canal opened on April 17 and the Canadian canal on April 13. As the commerce passing through these canals consists primarily of through business, these figures furnish a key to the water-borne trade of the Lake Superior section of the United States and Canada.

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Auxiliary Naval Vessels

Classification of Naval Vessels—Description of the Destroyer Tender Melville

The great variation in the composition of groups and types of vessels in the naval establishment of a first class power may, perhaps, be conceived by scrutinizing the list appended below, comprising, it is believed, all the units as they would appear in active service:

A.—Fighting Ships.
- (1) Battleships of the first line.
- (2) Battleships of the second line.
- (3) Armored cruisers.
- (4) Cruisers of the first class.
- (5) Cruisers of the second class.
- (6) Cruisers of the third class.
- (7) Destroyers.
- (8) Torpedo boats.
- (9) Submarines.
- (10) Gunboats.

B.—Coast and Harbor Defense Ships.
- (1) Monitors.
- (2) Coast defense ships.

C.—Dispatch Ships.
- (1) Scouts.
- (2) Converted yachts.

D.—Auxiliary Ships.
- (1) Supply ships.
- (2) Hospital ships.
- (3) Oil fuel ships.
- (4) Colliers.
- (5) Transports.
- (6) Mine layers.
- (7) Mine sweepers.

E.—Miscellaneous Ships.
- (1) Tugs.
- (2) Coal barges.
- (3) Ash lighters.
- (4) Water barges.
- (5) Ammunition lighters.
- (6) Freight lighters.
- (7) Floating workshops.
- (8) Floating derricks.
- (9) Garbage lighters.
- (10) Ferry boats.
- (11) Mud scows.
- (12) Dredges.
- (13) Diver barges.

The vastness of the scope for administration, operation, design and construction covering such a complexity of units, will be conceded when a little thought is bestowed on the fact that each type of the vessels enumerated represents an individual design made to fulfill a given purpose and to perform a certain predetermined work during operations.

Under the name "Supply Ships" as given in the list, there are to be found two separate more or less distinctive classes, viz.:

A. Tenders for submarines.

B. Tenders for destroyers.

Of the former type of recent construction the submarine tender *Fulton* was described in the issue of July, 1914, of this journal, and as representative of the latter class the present article will deal with the destroyer tender *Melville.*

It is a well-known fact that the dimensions of destroyers or submarines are as yet not of such proportions as to render them independent in their actions for any length of time, when cut off from access to supply depots. It might properly be mentioned that as a result of the limited capacity of such vessels, together with the very exacting demands placed upon them in service, the construction of tenders or supply ships was essentially born.

In the presentation of a description of ships belonging to the naval service, the indulgence of the reader is hoped to be cheerfully forthcoming for omissions of data pertaining to different arrangements on the ground of their military importance.

The liberal policy of the United States Navy Department in permitting the publication of facts of technical value pertaining to naval construction must be appreciated, when consideration is given to the fact that the entire foreign engineering press at present is practically closed for any purpose of giving information of matters pertaining to marine engineering.

Service Characteristics

As the service intended to be performed by ships coming under this class of vessels is to supply munitions of war, provisions and stores, the interior arrangements are made primarily with a view to meet this purpose. There are also arrangements made on board to care for a large number of sick or otherwise incapacitated.

Among the supplies which a tender will be called upon to provide we find the following:

A. Air, compressed and carried in flasks.
B. Ice and refrigerated supplies.
C. Light and electric current.
D. Fresh water.
E. The output from machine shops for necessary repairs.
F. Hospital service (for which provision of 38 beds has been made).

Besides machinery and output for the supply of foregoing necessities, storage is provided for torpedoes, mines and ammunition, meats, stores and provisions.

General Features

The general appearance of the new destroyer tender *Melville,* as shown in Fig. 1, with its two masts and straight stem, somewhat resembles an ocean liner, but becomes distinctly military in the light of the batteries, consisting of eight 5-inch 51 caliber rifles and two 3-pounder saluting guns.

The general dimensions and data pertaining to the ship are as follows:

Length between perpendiculars	400 feet
Breadth	54 feet 5½ inches
Depth	20 feet
Displacement (normal)	7,150 tons
Oil fuel carried	900 tons
Speed, in knots	15
Total horsepower, main turbines	4,000
Number of shafts and screws	One
Type and number of boilers	Two B. & W.
Total heating surface, square feet	7,000
Three generating sets, 100 kilowatts each	125 volts
Total complement of officers and crew	254
Name of builders	New York Shipbuilding Company

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Launched ..... March 4, 1915
State of finish ..... 90 percent
Cost of vessel, complete $1,310,000 (£268,000)

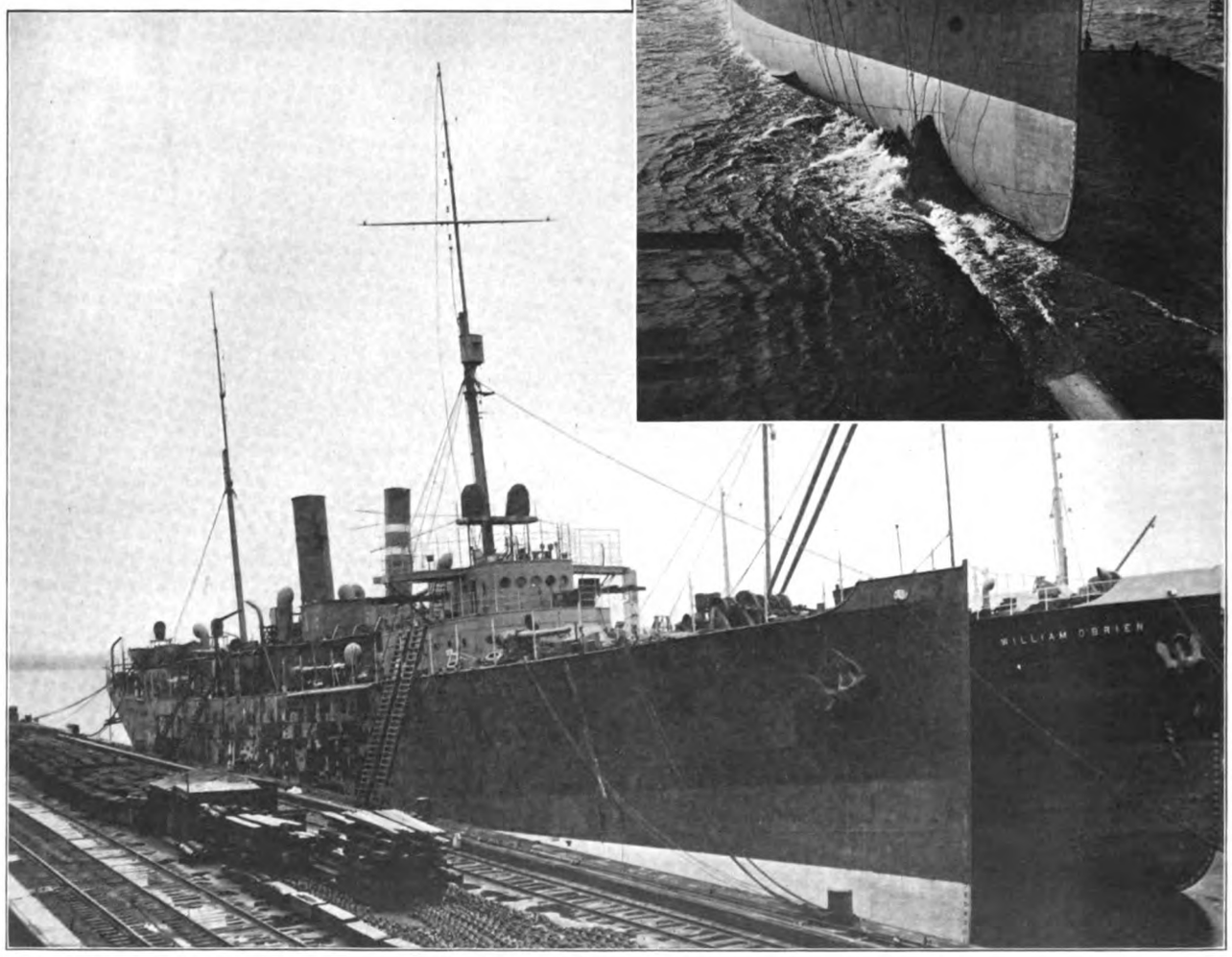
General Hull Arrangement

There are three principal decks, consisting of main deck, second and third deck. Below these decks forward is placed a platform deck which extends aft as far as possible and also partially amidships. Below the platform deck is the hold, divided into suitable compartments, among which are trimming tanks, hold space, stores and space for any provisions. On the deck spaces above are to be found special storerooms, cold storage rooms and magazines, officers' quarters aft and crew space forward. On the main deck are located three deck houses. In the forward deckhouse are arranged, besides the commanding officer's cabin and office, executive offices and navigating officer's stateroom. Similarly in the after deckhouse there are located the junior officers' staterooms and the flotilla commander's office and cabin. Within the deckhouse placed amidships there are situated the engine room hatchway, coppersmith and blacksmith shops, a foundry, the general storekeeper's and paymaster's office and a trunk for the smoke pipe, together with various other smaller compartments.

Machinery Arrangement

The driving power in this ship is developed by steam turbines, while in the submarine tender *Fulton* the corresponding power is produced by a Diesel engine.

The engine room is divided below the main deck into three compartments of which the center compartment constitutes the turbine room, while each wing compartment constitutes an auxiliary engine room. There are located in the starboard engine room three ice machines, the auxiliary condenser, and, above on a gallery, the generators with switchboard. In the port engine room below the gallery are to be found the main condenser, the main air and circulating pumps and feed tanks, and on the



(Phhotographs by the New York Shipbuilding Company)

Fig. 1.—U. S. S. *Melville* Fitting Out at the Builder's Yard

Fig. 2.—Launch of the *Melville*

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gallery four double effect evaporators, together with the necessary pumps.

Forward of the engine compartment is the boiler compartment, where are placed, besides the boilers, fuel oil settling tanks, pumps and blowers.

The capacity of the evaporating plant is about 25,000 gallons for each twenty-four hours, and each of the three ice machines will yield 3 tons of ice every twenty-four hours. The three turbo generators are each of 100 kilowatt capacity.

There are placed in the machinery spaces numerous

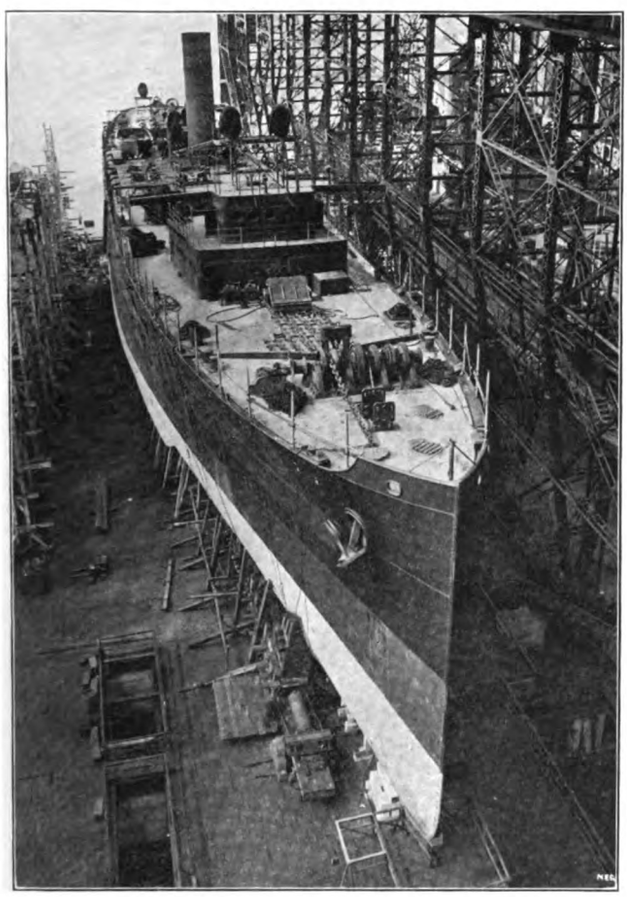

Fig. 3.—U. S. S. *Melville* on the Ways Previous to Launching

other auxiliaries, such as the main and auxiliary feed pumps, fire and bilge pumps, lubricating oil pumps, evaporator feed and fresh water pumps, fuel oil supply pumps and burner pumps. The distillers are placed at a higher level in the engine room hatch.

The turbine machinery is of Parsons type and consists of two separate turbine units, of which the high-pressure unit is placed on the starboard side and the low-pressure unit on the port side of the ship.

The transmission of power from turbines to the propeller is effected by means of a Westinghouse mechanical reduction gear, consisting substantially of a pinion on each turbine shaft meshing with a gear wheel attached to the center shafting driving the propeller. The propeller revolves at a speed of 110 revolutions per minute, while the turbines run at 1,400 revolutions. The speed of transmission is thus reduced in a ratio of 140 to 11, or nearly thirteen times.

The gearing is of the double spiral type with the teeth of each cut in the opposite direction. Each pinion transmits 2,000 horsepower, and being of the same diameter, revolves at the same speed, viz., 1,400 revolutions per minute. The gear wheel center is made of cast iron, the rim of cast steel and the shaft of mild steel forging, while the pinions are made of rather high grade steel forgings and the pinion driving shafts of chrome nickel steel. The angle of the spiral is about 30 degrees and the width of face is 16 inches for each single gear, making a total width of driving face of 32 inches with 40 tooth contact points with a contact pressure of 562 pounds.

The general advantages claimed for transmission of the propulsive power by means of reduction gearing as compared with straight turbine drive are:

1. About 15 percent increase in the economy of coal consumption.

2. Average reduction in the weight of the machinery about 15 percent.

3. The reduction in the size of turbine rotors, which is of practical advantage in handling, as well as general reduction in the size of turbines.

To meet the requirements for successful operation, the gearing must be durable, practically noiseless with the transition of pressure from tooth to tooth without shock.

The bearing supports of the pinions for mechanical gearing are made sometimes rigid and sometimes with floating arrangements, both of which have given satisfaction. The Westinghouse gearing is provided with a hydraulic floating arrangement for each pinion, and is now made for several United States vessels.

Steamer Emblane

A unique vessel designed by George Owen, naval architect, of Newton, Mass., for special service in experimenting with and testing the torpedoes built by the E. W. Bliss Company, Brooklyn, N. Y., has recently been completed by the Bath Iron Works, Bath, Me. The vessel, known as the *Emblane*, is 130 feet 7 inches long overall, 125 feet long between perpendiculars, 31 feet 6 inches extreme beam, with a draft of 6 feet on a displacement of 308 tons.

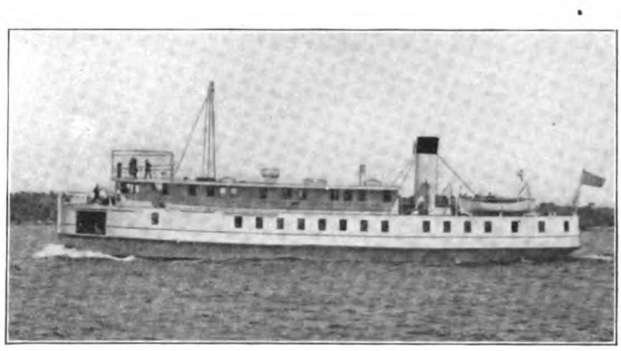

Fig. 1.—Torpedo Testing Steamer *Emblane*

The home port of the *Emblane* is Sag Harbor, at the eastern end of Long Island. From Sag Harbor she makes daily runs to her moorings on the torpedo range in Gardner's Bay, where the torpedoes are tested on the long range of 12,500 yards, or a little over seven miles. After the day's work, the *Emblane* returns to Sag Harbor.

The general arrangement of the steamer and the principal scantlings of the hull are shown in Figs. 2 and 3. Propulsion is by a three-cylinder, triple expansion engine, designed and built by the Bath Iron Works. The cylinders are 8, 13 and 21 inches diameter by 15 inches stroke.

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Steam is supplied by two Almy watertube boilers at 250 pounds pressure. The boilers are oil-fired by the White system, and the oil is carried in large tanks of sufficient capacity to supply two weeks' continuous use.

The main condenser is the Bath Iron Works expanded tube type, the circulating pump a Kingsford centrifugal pump and the feed and donkey pumps of the Blake type. The auxiliaries also include a 7-kilowatt General Electric generator, which, in conjunction with a 100-cell Edison storage battery, provides efficient lighting for the steamer. Steering is by a Hyde steam steering gear located in the engine room.

In the large center compartment in the hold are two air compressors made by the Laidlaw-Dunn-Gordan Company, which, through an elaborate system of piping, compress air to a pressure of 3,000 pounds per square inch. This compressed air is stored in air flasks and is used as the propelling medium for the torpedoes. The large center compartment in the hold also contains the fuel oil tanks and reserve fresh water tanks.

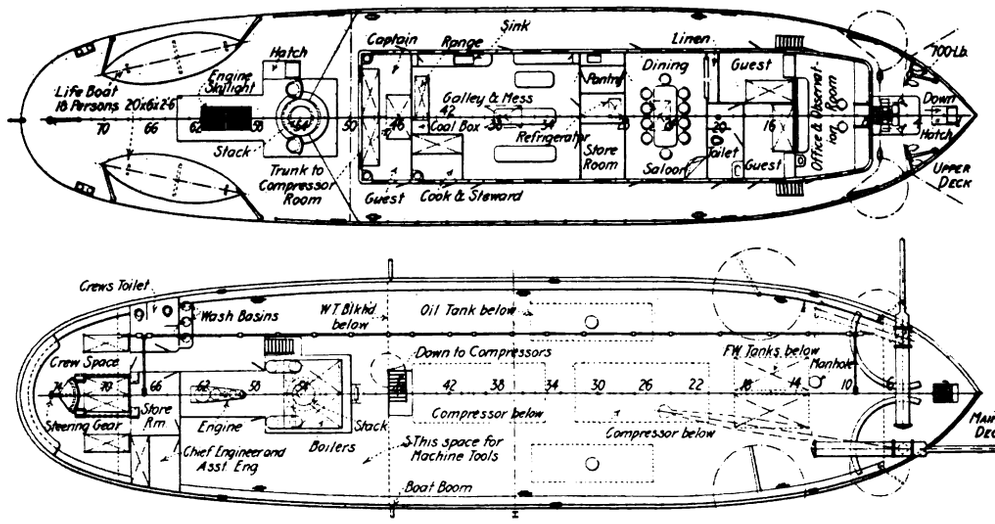

Fig. 2.—Deck Plans of the *Emblane*

Forward on the main deck are two torpedo launching tubes with space for storing twelve to eighteen torpedoes. Aft on this deck are the crew's quarters and rooms for the mate and assistant engineer. On the upper deck, forward, are the observation cabin, two staterooms for guests, a guests' dining room, pantry and galley and the crew's messroom, as well as staterooms for the captain and chief engineer. A crew of thirty-six men is carried.

Although the maximum speed of the *Emblane* was estimated as eleven statute miles per hour, yet on her official trial trip over a measured mile course she attained a maximum speed of 11.23 statute miles per hour, the engines developing 260 indicated horsepower at 245 revolutions per minute. On her run from Bath, Me., to her home port, Sag Harbor, Long Island, a distance of 321 statute miles, the *Emblane* averaged a speed of 10.98 statute miles per hour, although this was her first run after her trial trip, and was made in a very rough sea.

In the design of this steamer appearance was necessarily subordinated to the specific demands for her service as a work boat for handling large and heavy torpedoes, for which she has proved very efficient, yet her type, with a few modifications, would make a most excellent houseboat, or small freight and passenger steamer for inland waters. The construction of the vessel was supervised by George Owen, her designer.

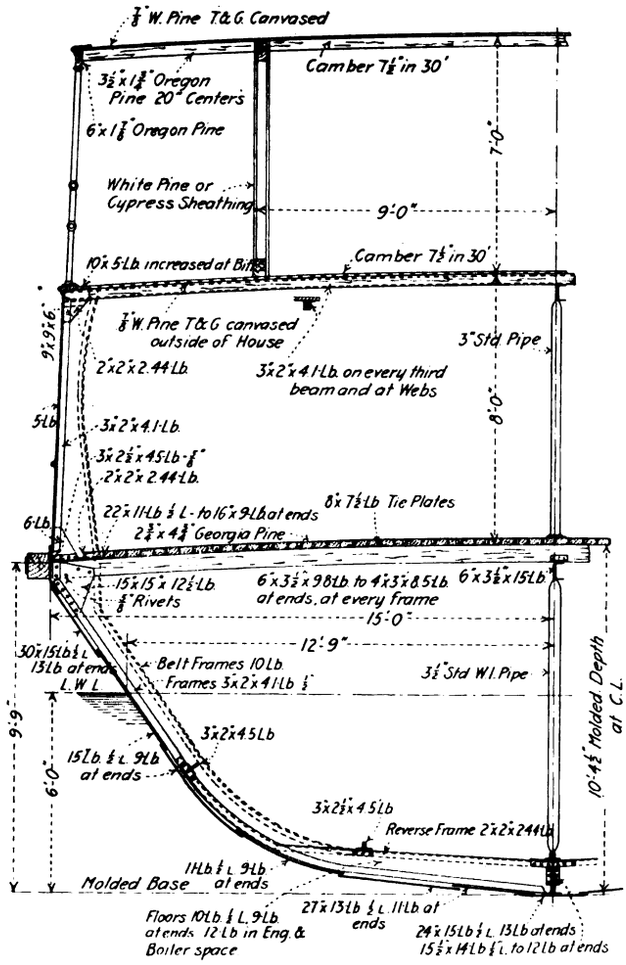

Fig. 3.—Midship Section

ILLINOIS RIVER 8-FOOT WATERWAY.—The Illinois State Legislature has recently passed a bill providing for a waterway of 8 feet draft connecting the Chicago drainage canal at Joliet with the Illinois River at La Salle, a distance of 65 miles. The work will be partly river improvement and partly canal and will probably be completed in two years, forming a link in the Lakes and Gulf waterway.

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The Marine Terminals of Beaumont, Texas

Development of 55 Acres of Land and Water Areas for an Industrial Terminal on the Nechez River

BY H. MC L. HARDING *

Texas has an enormous hinterland, rich in the fertility of its soil, agricultural products and mineral resources, and rich in its peculiar energy-producing climate, but its harbors for ocean-going ships are few in number. Along much of its coast there is little deep water, for the Gulf of Mexico near the coast is shallow and generally for a distance of half a mile from the shore there is a depth of only six feet at low water.

There are, however, a few deep water channels extending inland, one of which is the Nechez River. On this river, about fifty miles from the Gulf of Mexico, is the harbor of Beaumont. Beaumont is within the eastern portion of Texas, and its port will serve an extensive area, larger than that of the New England States. There is a channel about 25 feet in depth from the Gulf to the quays of the city, and a turning basin, dredged in front of the quays, and even now its area is greater than the Thames at the port of London. When the dredging now going on is completed, this turning basin will be in the form of an oval, the dimensions being about one-half by one-third of a mile. The city was fortunate in being able to secure a large plot of land within a thousand feet of the court house, called "Kirby Point," around three sides of which flows the Nechez River. With the land and water areas there are available about fifty-five acres for an industrial or local terminal.

Commerce Terminal

On the other side of the river bordering partially on this basin is another area of hundreds of acres of sufficient size for a commercial or through-freight marine terminal for all of Texas.

Here will be established a large railway service yard, comprising the receiving, classifying and storage tracks, a transfer station, and large cotton, rice and other warehouses, both for outbound and inbound cargoes, as well

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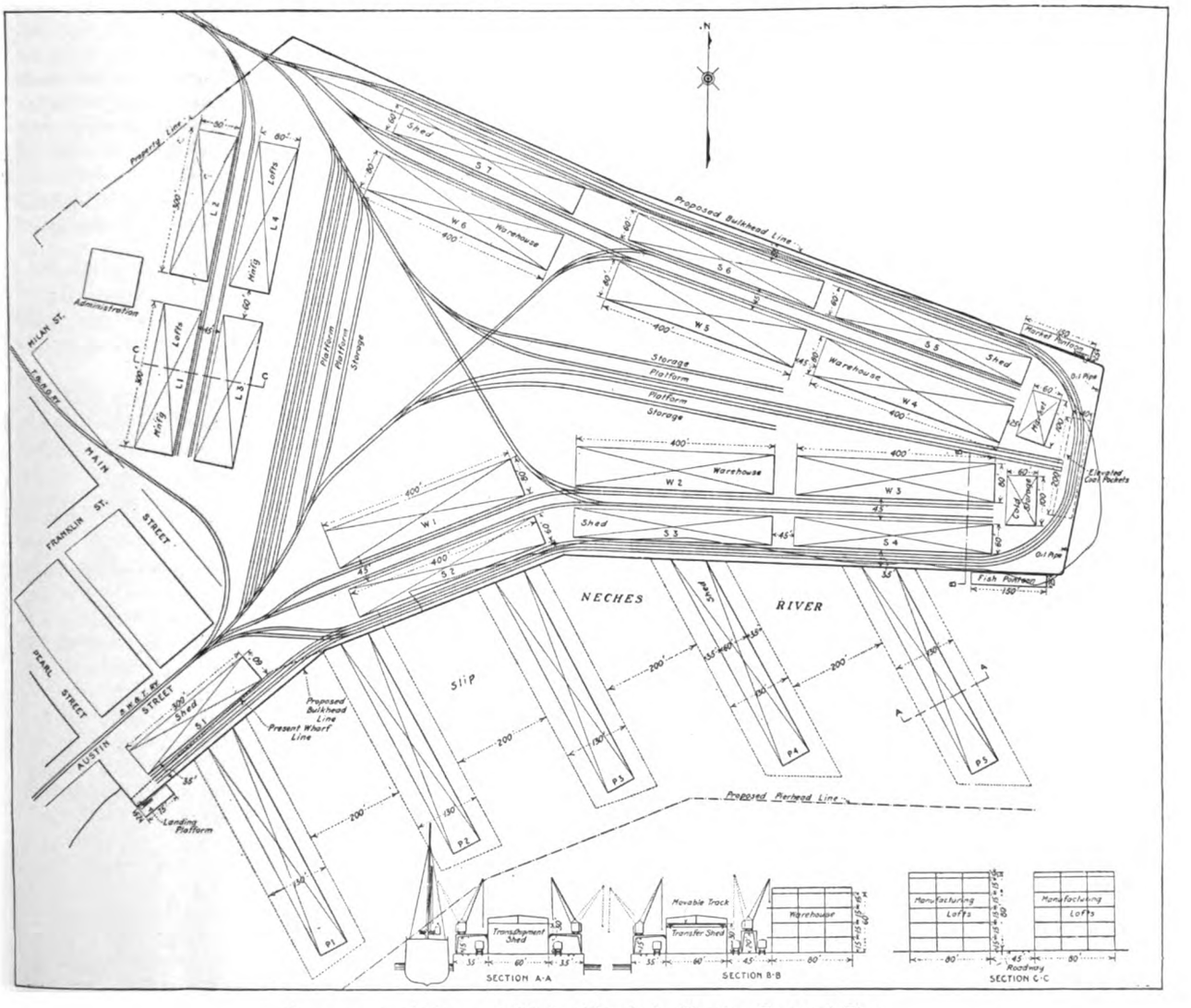

Arrangement of Beaumont Marine Terminals, Showing Proposed Piers

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as large open spaces for the storage of coarse and bulk freight not affected by climatic conditions. The dry docks of the port will later be built here.

Much of this land, being low lying, is admirably adapted for a commercial terminal, being much preferable to places where there are high banks.

INDUSTRIAL TERMINAL

The industrial terminal, of which the plan and sectional elevation are here given, is designed to be constructed on the unit system. A unit length of quay is equal to 500 feet, which is the length of a large freighter, such a unit being provided with a proportional length of shed, warehouse, necessary railway tracks, and also the transferring and handling machinery. A second unit can be installed without requiring any changes in Unit No. 1 or interruption of traffic.

Each unit complete, including the above elements with the dray area, the filling and paving, will make this total investment, without the land, of about $300,000 (£61,500). The seven units with the fish and farm markets, the cold storage and administration buildings, the manufacturing lofts, sheds, railway approaches and storage tracks, will require an investment of about $3,000,000 (£615,000).

Additional units will be constructed according to the demands of traffic.

MECHANICAL TRANSFERENCE AND HANDLING

As will be seen from the elevation, freight is transferred by the traveling gantry jib cranes, either to the car, to the quay or the shed, and by the overhead traveling hoists and movable tracks will be assorted, distributed and tiered in the shed, and by other cranes, which will be at the rear of the shed, freight is transferred by one direct movement from the shed to any story of the warehouse.

BELT RAILROAD

All the important trunk lines of Texas converge towards Beaumont, and the new lines projected will tap other States to the north of Texas. By means of the terminal railway tracks and the present belt line railroad, cars can be switched between any of the railroads entering Beaumont, and any shed, warehouse or storage place within the terminal. The railway tracks are between the shed and the waterway and between the shed and the warehouse, thereby affording complete co-ordination.

PROJECTING PIERS

At first along the river banks of the terminal there will be constructed only the concrete quay walls. Later the projecting piers will be added according to the increase of the tonnage.

For the present and future development of the industrial terminal there will be, beside that area mentioned, about 325,000 square feet of pier space, 575,000 square feet of slip space, and 60 acres in addition in the turning basin. There will be 9,275 feet of lineal frontage, over which, when mechanically equipped with the latest appliances, and intensively worked, there can be transferred annually over 3,000,000 tons of miscellaneous cargoes.

This lineal frontage will be utilized as follows: Discharging and loading berths for 13 ships, each 500 feet in length; 1 ship, 450 feet in length; 2 ships, each 300 feet in length; 3 ships, each 150 feet in length; 3 ships, each 125 feet in length; total, 22 ships.

Other quay wall frontage between the piers will be reserved for barges, lighters, river craft and for smaller vessels.

The seven transfer sheds on the quays and the five trans-shipment sheds on the piers will be of steel and will have a total holding or short-time storage capacity of 114,500 tons. In the concrete warehouses there will be a long storage capacity of 150,000 tons. The open storage spaces for outside freight will amount to approximately 300,000 square feet, while the concrete manufacturing lofts will have a combined floor area of 620,000 square feet. There will be an administration building, the farm and fish markets and cold storage building. Coal pockets and oil pipes are located where vessels can be supplied with the least discomfort to the remainder of the terminal.

FREIGHT MOVEMENTS

The principal freight movements will be between the vessel and the pier, quay, shed, car, dray or large motor truck, and also between the shed and car and the different stories of the warehouse, all of which movements will be effected by machinery.

CRANES AND OTHER MACHINERY

The following are the characteristics of the traveling gantry jib cranes.

Two types of cranes are used, one the half arch and the other the full arch.

Normal load, 3 tons.

Over-reach, 45 feet.

Horizontal distance between crane tracks, 32 feet.

Maximum height of lift, 70 feet.

Lifting speed, 3 tons at 150 feet per minute.

Lifting speed, 1½ tons at 200 feet per minute.

Motive power, electricity, direct current, either 550 or 220 volts, D. C.

Fifty or sixty cycles or drafts per hour.

There will also be transfer bridges for lumber and structural steel, and conveyors for special commodities.

In the sheds will be overhead traveling transfer cranes and electric traveling hoists with a hoisting and carrying capacity of two tons each, for the assorting, distributing and tiering of miscellaneous freight. The hoists will be operated in trains. For long movements, motor trucks will be used.

The quay walls above low water will be composed of concrete. This type of wall with no wood entering into the construction except that which is below low waterline, which, being always wet, is decay resisting and fireproof.

It is expected that the first unit will be completed and ready to add to the capacity of the present wharves within the next few months.

Development of Auxiliary Sailing Ships

New York harbor was recently visited by the Norwegian auxiliary sailing ship *Elfleda,* owned by the Trans-Atlantic Motor Ship Company, Ltd., of Christiania, Norway. The *Elfleda* is a square-rigged vessel 226 feet long, 36 feet beam and 21 feet 9 inches depth, with a gross tonnage of 1,240 tons and a deadweight carrying capacity of 1,900 tons. The auxiliary power plant consists of two 120 horsepower Bolinder oil engines driving twin screws. On her voyage across the Atlantic to New York the vessel averaged a speed of 9 knots, the total fuel consumption for the entire trip being 12 tons. The guaranteed maximum fuel consumption of these engines is .58 pound per brake horsepower per hour, which, with oil at 3 cents (0/1½) per gallon, means a cost per hour of only 55 cents (2/3½).

Two other auxiliary sailing vessels equipped with Bolinder engines are owned by the Trans-Atlantic Motor Ship Company, Ltd. One of these is the *Fingal,* 308 feet long, 42 feet beam and 24 feet depth, with a deadweight carrying capacity of 3,900 tons. She is equipped with two 160 horsepower Bolinder engines. The other is the

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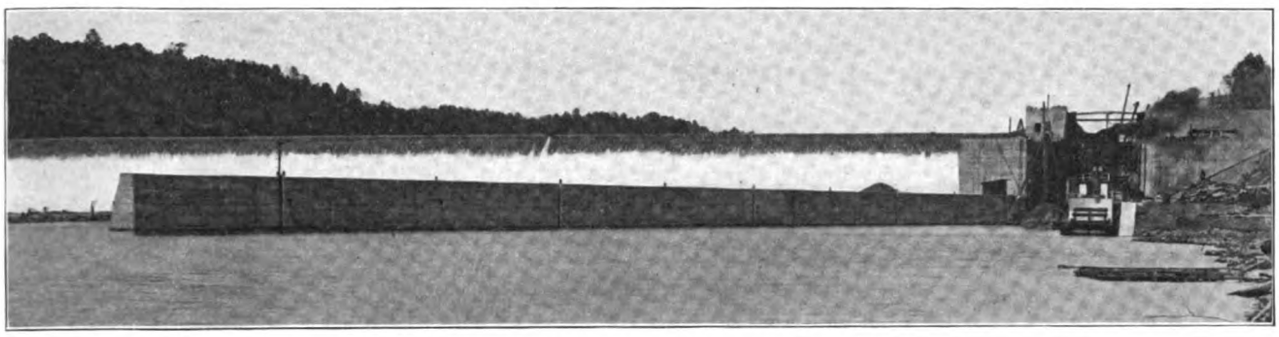


General View of Locks and Dam No. 17 on the Black Warrior River, Ala.

Lota, 232 feet long, 37 feet beam and 21 feet 6 inches depth, with a deadweight carrying capacity of 2,100 tons. Like the *Elfleda* she is equipped with two 120 horsepower Bolinder engines, although she is about 10 percent larger.

This company has also recently purchased five other sailing vessels, which will also be equipped with Bolinder engines for auxiliary power.

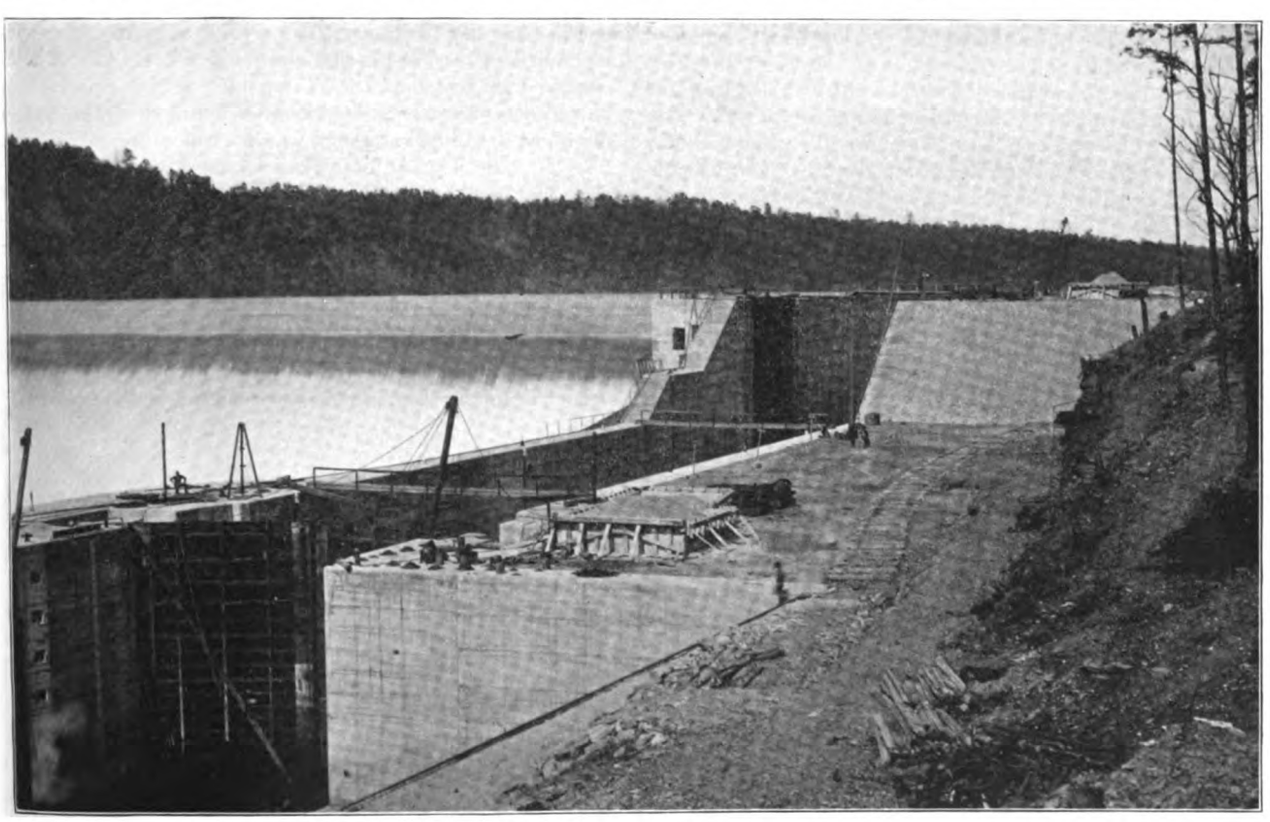
Completion of Locks and Dam No. 17 on the Black Warrior River

The locks and dam No. 17, which are the key to navigation of the Mobile, Tom Bigbee and Tuscaloosa rivers between Mobile, Tuscaloosa and the Alabama coal and mineral fields, were officially opened on May 13. The completion of these locks will enable coal, iron and other products to be transported to Mobile for about 65 cents (2/8½) per ton.

Locks and dam No. 17 are located on Squaw shoals, Black Warrior River, Alabama, 26 miles north of Tuscaloosa, Ala., and 12 miles from Birmingham, Ala. What is known as Squaw shoals represents a fall of 40 feet in a stretch of about 4 miles, and this is more than overcome by lock and dam No. 16 and locks and dam No. 17. Lock and dam No. 16, with a lift of 21 feet, located at the foot of Squaw shoals, backs the water up to the base of the dam No. 17, a distance of 1½ miles. By means of channeling and excavating in the lower approach of locks No. 17 a channel 7 feet deep was obtained from dam No. 16.

Locks and dam No. 17 comprise a flight of two locks of 31½ feet lift each and a dam of 63 feet lift. They represent an expenditure of 3,000,000 (£615,000) by the United States Government and are the last of a system of dams and locks on the Black Warrior River, which altogether represent an expenditure of about $15,000,000 (£3,075,000). This system provides a channel 6 feet deep for slack water navigation the year round from Mobile to the coal and mineral fields of the Birmingham district.

The construction of these locks was in charge of Mr. G. K. Little, assistant engineer of the United States Army Engineer Corps, assisted by Mr. S. T. Jones, Jr., while the actual construction was carried out by B. H. Hardaway & Co., of Columbus, Ga., contractors. L. E. G.



Locks and Dam No. 17, Black Warrior River, Ala. View of Approach from Side Bank

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Large Motor-Driven Railway Train Ferry

Description of an Unusual Vessel Built on the Pacific Coast for Train Ferry Service in San Francisco Bay

BY CHARLES J. BELDEN

Probably the most noteworthy motor-driven vessel outside of Europe has been completed recently in California, and is at the present time in continuous service. Both the hull and machinery equipment possess features of unusual interest to those who have followed marine engineering developments of the past few years, and the progress of this installation has been watched with considerable interest by Pacific Coast engineers.

The *Ramon,* as this vessel was christened, was built by the Oakland, Antioch & Eastern Railway and is being used to transport their trains across an arm of San Francisco Bay. The main line of this road operates between Sacramento and San Francisco, Cal., through the rich farming lands found in the deltas of the San Joaquin and Sacramento rivers, and the construction of the road over this low-lying country has necessitated building many miles of bridges and trestle work. At one point a considerable expanse of water had to be crossed, and it was decided that the most feasible way for negotiating this stretch would be to ferry the trains over on a boat. This method has been used for a great many years by the Southern Pacific Railway at a similar point in connection with their transcontinental line.

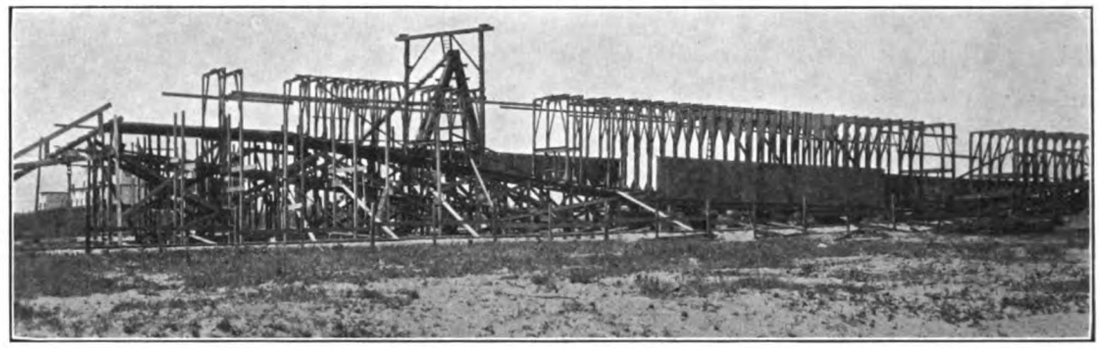

Fig. 1.—General View of the *Ramon* under Construction

In considering the construction of a suitable vessel, the engineers of the road had three main considerations to take into account, namely, reliability, economy and time of delivery. Of course it might be said that the first two are the prime considerations for any marine installation, but they were of especial importance in the present case on account of the nature of the service for which the vessel is intended. Reliability was a vital point, as the schedules of the whole system would be upset by any interruption in the service of this boat, which, as stated above, was to operate at a point on the main line of the road. The relative economy of steam and internal combustion engines in intermittent service was carefully considered, with the result that the latter were adopted principally on account of the saving effected by this type of power between trips. It was also found that the use of distillate (paraffin) engines would reduce the size of the boat and the number of men necessary for its operation. The short time of delivery required for the complete installation was the consideration that influenced the design of the hull to a large extent, necessitating a departure from usual practice in order to expedite construction. The time factor also worked to the advantage of an oil engine equipment.

The hull of the *Ramon* is built entirely of steel, which

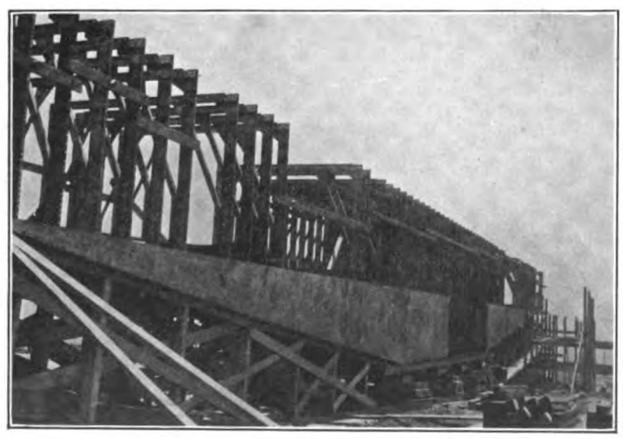

Fig. 2.—Central Girder Construction

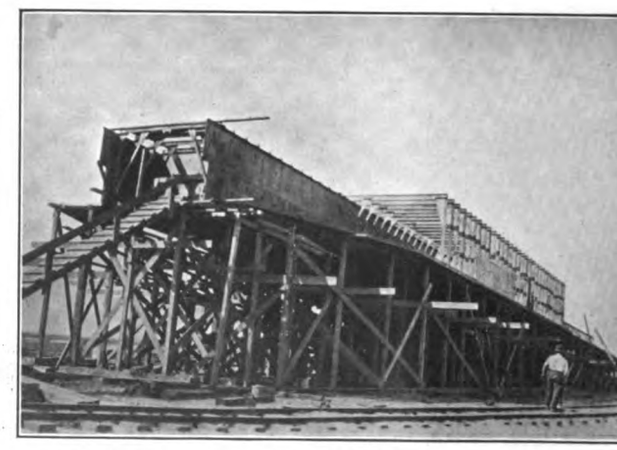

Fig. 3.—Construction on Either Side of Central Girder

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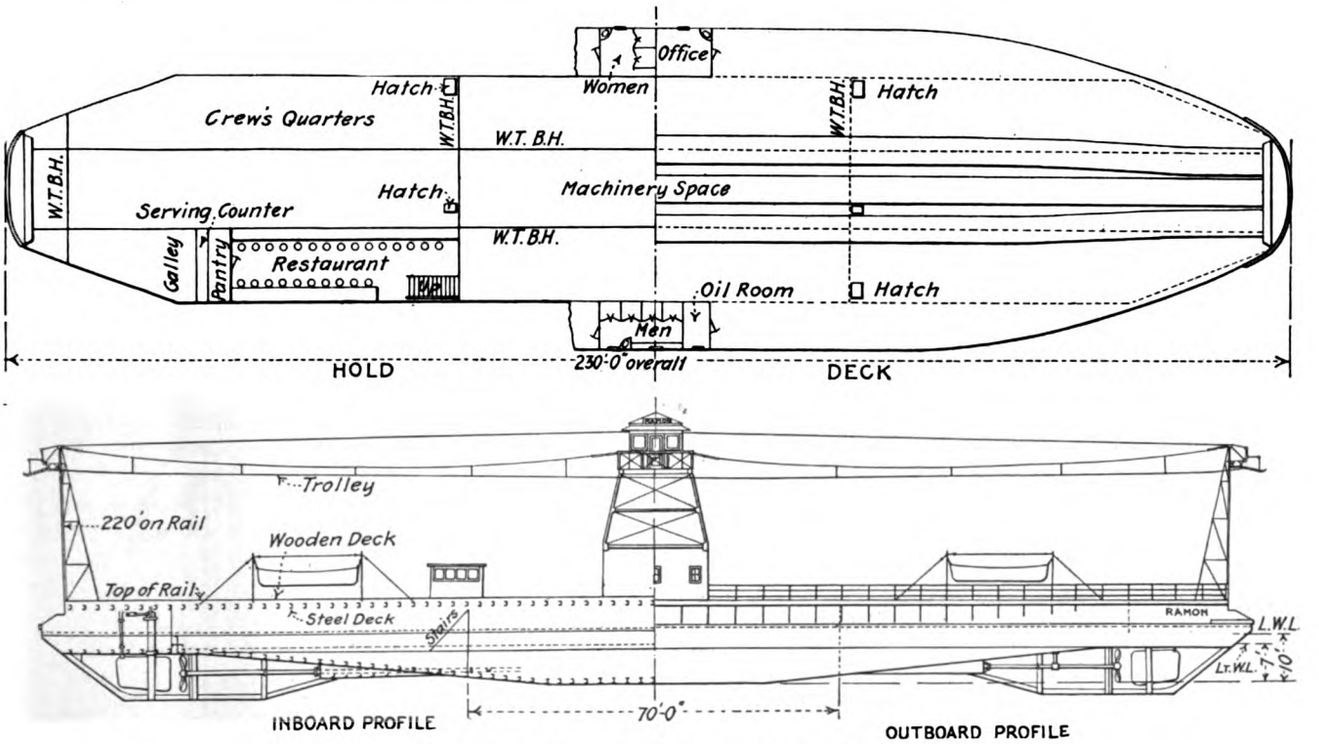

Fig. 4.—Deck Plan and Outside Profile of the *Ramon*

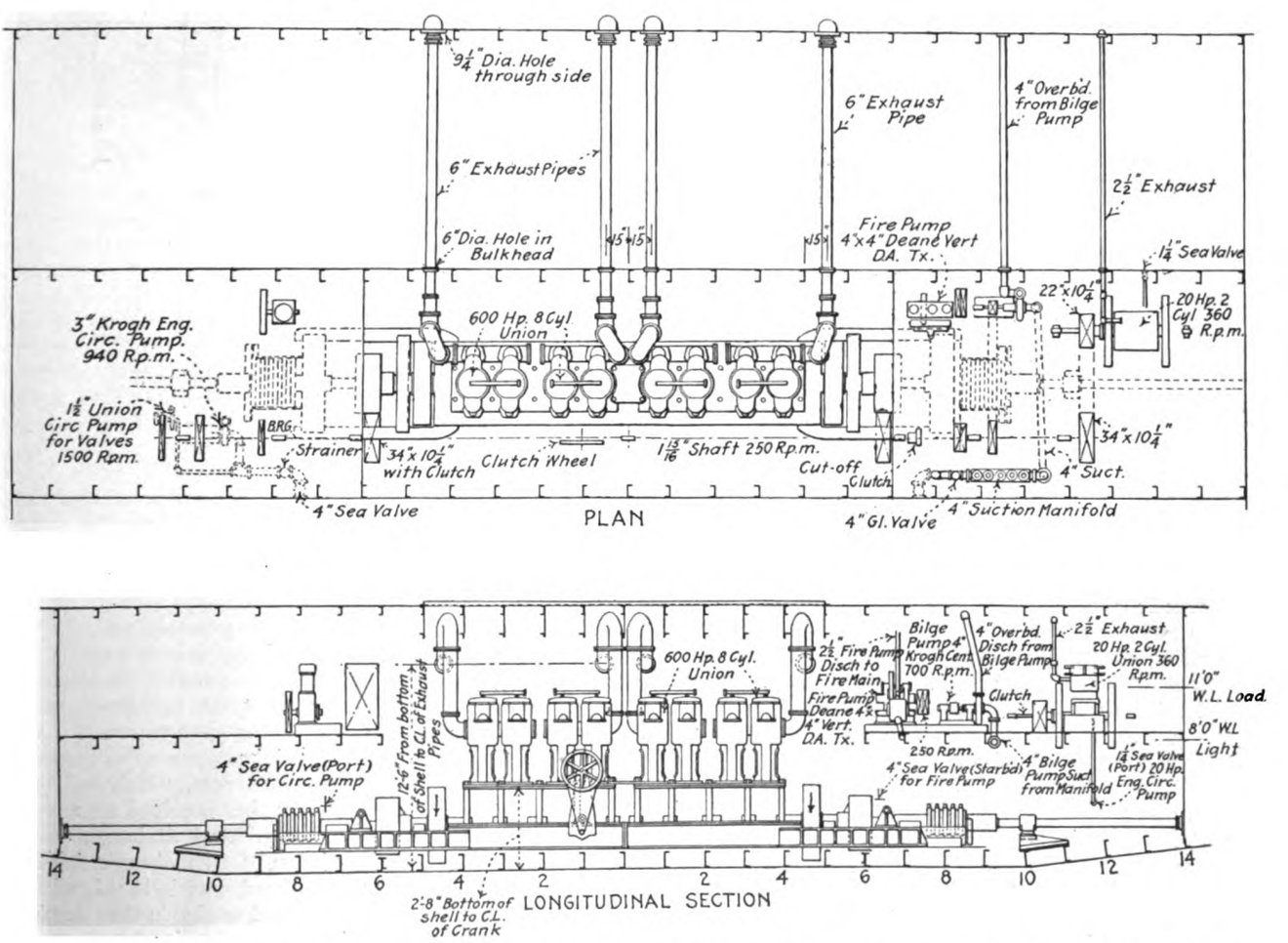
9¼" Dia. Hole through side
6" Exhaust Pipe
4" Overbd. from Bilge Pump
6" Exhaust Pipes
2½" Exhaust
6" Dia. Hole in Bulkhead
Fire Pump 4"x4" Deane Vert DA. Tx.
1¼" Sea Valve
22"x10¼"
20 Hp. 2 Cyl 360 R.p.m.
3" Krogh Eng. Circ. Pump. 940 R.p.m.
600 Hp. 8 Cyl. Union
1½" Union Circ Pump for Valves 1500 Rpm.
BRG.
Strainer
34"x10¼" with Clutch
Clutch Wheel
1 13/16" Shaft 250 Rp.m.
Cut-off Clutch
34"x10¼"
4" Suct.
4" Sea Valve
PLAN
4" Gl. Valve
4" Suction Manifold
600 Hp. 8 Cyl. Union
2½" Fire Pump Disch to Fire Main
Bilge Pump 4" Krogh Cent. 700 R.p.m.
4" Overbd. Disch from Bilge Pump
2½" Exhaust 20 Hp. 2 Cyl. Union 360 R.p.m.
11'0" W.L. Load
8'0" W.L. Light
Fire Pump Deane 4½" 4" Vert. DA. Tx.
Clutch
250 R.p.m.
4" Sea Valve (Starbd) for Fire Pump
4" Bilge Pump Suct from Manifold
1¼ Sea Valve (Port) 20 Hp. Eng. Circ. Pump
4" Sea Valve (Port) for Circ. Pump
12'-6" From bottom of Shell to Cl. of Exhaust Pipes
2'-8" Bottom of shell to C.L. of Crank
LONGITUDINAL SECTION

Fig. 5.—Engine Room Arrangement, Showing the 600-Horsepower, 8-Cylinder Distillate (Paraffin) Engine, Built by the Union Gas Engine Company, San Francisco

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was manufactured by a local rolling mill and erected by the railroad company. The total weight of the steel used amounts to 320 tons.

The principal dimensions of the *Ramon* are as follows: Length over all, 236 feet; breadth, 58 feet; maximum draft, 12¼ feet.

On account of the short time allotted for the construction of the vessel all curved plates were eliminated and a box-like design was adopted which allowed for the use of flat plates throughout. The hull is built about a central girder formed by two longitudinal bulkheads extending the entire length of the boat, Figs. 1 and 2. In this way extreme longitudinal stiffness and general rigidity have been obtained. The engine room is located between these two bulkheads, thus providing an exceptionally stiff engine bed necessitated by the length of the engine—i. e., 46 feet. The fore and aft limits of the engine room, which is 70 feet long by 13 feet wide by 16 feet deep, are determined by two transverse bulkheads extending the entire width of the vessel. These two additional bulkheads divide the hull into eleven watertight compartments, making it well nigh unsinkable. At either end of the engine room is located an intermediate deck, on which the auxiliary machinery is located.

It will be seen from the side elevation that there are two deck houses which form the base for the pilot's bridge. These houses will contain toilets, a lamp room and cabin. The crew's quarters, galley and dining room, seating sixty people, are located below decks.

At either end of the boat there are two steel towers for carrying the trolley wires which make contact with the wires on the apron through switches controlled from the pilot house. The three tracks on deck will each be 220 feet long, accommodating a total of twelve passenger coaches. The rails will be flush with a wooden deck which will be laid over the steel deck, thus insuring the safety of passengers promenading while the boat is in transit. The propeller and balanced rudder on either end will be protected by a skag constructed of two 10-inch ship channels with a 10-inch by 16-inch timber between them.

PROPELLING MACHINERY

The propelling machinery of the *Ramon* possesses unusual interest, as it consists of the largest internal combustion motor of the electric ignition type ever built in any part of the world. This fact can be readily appreciated when it is stated that the completed engine will weigh approximately 100,000 pounds, its total length being 46 feet.

The engine is an eight-cylinder unit designed to develop 600 horsepower at a normal speed of 200 revolutions per minute. It is an "open crosshead type" engine, and its construction has been undertaken by the Union Gas Engine Company of San Francisco. This type of distillate (paraffin) engine is perhaps one that will not be familiar to British engineers, as it has been developed solely on the Pacific Coast. The open crosshead in this case is slightly different in design from that which obtains in steam and large Diesel installations, and consists of a water jacketed extension on the lower end of the cylinder which acts as a crosshead guide. The piston is exceptionally long, and the lower end, which holds the wrist pin, acts as a crosshead. There are openings fore and aft in both cylinder and piston, thus allowing a circulation of air about the wrist pin. The inlet and exhaust valves are disposed on either side of the cylinder in the familiar "T" head arrangement; the exhaust valves are water cooled. It will be seen from the profile of the engine room arrangement that the cylinders are grouped in four pairs to correspond to the four sections of the crank shaft.

The fuel that is to be used is known on the Pacific Coast as "engine distillate" and corresponds closely to British "paraffin." The vaporizing device consists of two carburetors used in connection with two jacketed inlet manifolds of special construction, heated by the exhaust gases in order to prevent condensation of the heavy fuel. Each manifold supplies four cylinders. Lubrication of the cylinders and bearings will be accomplished by means

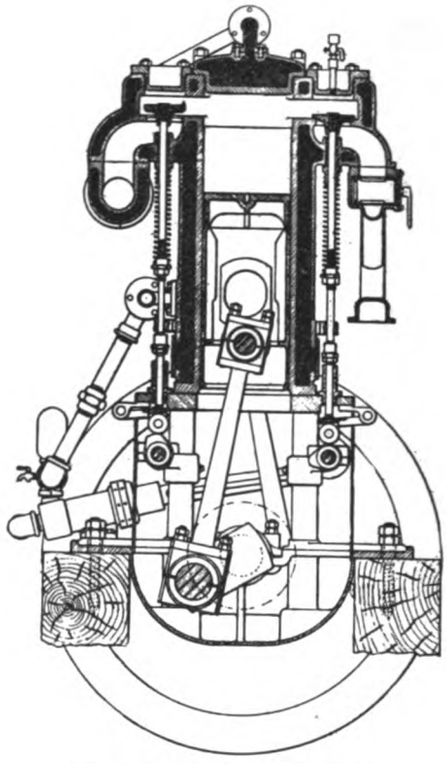

Fig. 6.—Cross Section of Engine

of force feed lubricators mounted on the back of the engine and driven from the cam shaft. The crank-pin bearings are lubricated by a centrifugal ring oiling device mounted on each crank web and connecting with oil holes leading out to the center of the crank-pin.

The engine is placed in the center of the hull, as shown in the engine room plan, and is connected to a four-bladed propeller, 72 inches in diameter, on either end. The *Ramon*, as stated above, is double-ended, and in order to eliminate the necessity of a reverse gear the two propellers are made of opposite pitch and are thrown in and out of action by a clutch mounted on each end of the engine. At one end of the engine room a 20-horsepower, two-cylinder, distillate engine is belted to a generator for supplying current for lighting purposes about the ship and also to the coaches in transit.

This installation of 600 odd horsepower will require only one engineer in the engine room, which will be a considerable reduction in the number required for a steam plant of equal capacity. The greatest saving, however, will be shown in the elimination of all fuel expense while the vessel is tied up at the wharf, and it is this consideration that will undoubtedly lead to the further development of the internal combustion engine for ferryboat service, especially about San Francisco Bay, where this type of vessel is used to a large extent.

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Davits and the New Requirements*

BY HARRY W. BROADY †

CLASS D DAVITS

The pivoted davits, Class D, are the most numerous of all classes and there are now probably more than 2,000 patents granted for davits coming within this class—and more are being allowed all the time.

The simplicity of the theory of working, namely, only to swing a pivoted arm out, is very deluding. All the davits of this class have some very serious disadvantages. First of all, is the very excessive amount of power needed to swing a boat out or in, and therefore the attendant uncertainty of action in these davits under severe conditions. Each davit usually consists of an arm pivoted at its lower end to brackets fastened at the outer edge of the deck.

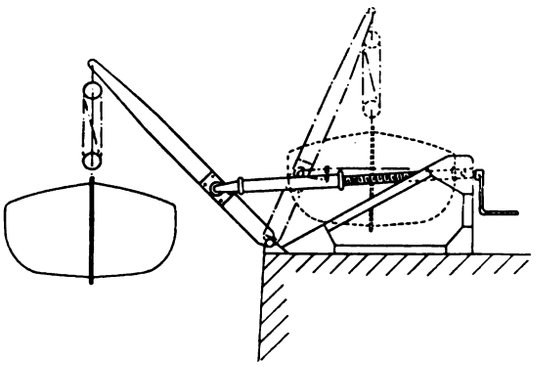

Fig. 6.—Norton Sheath Screw Davit

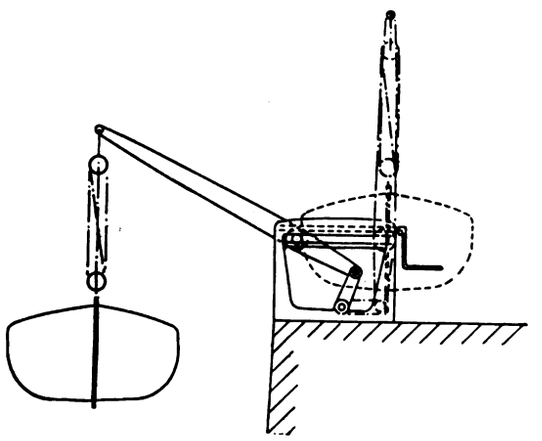

Fig. 7.—Hale Pivoted Davit

The arms must reach inboard so far that the upper end or eye is just above the centerline of the boat. The placing of the brackets as close as possible to the ship's side is necessary so as to give as short an arm as practicable.

The arms are swung in and out by means of some screw or link device which generally is connected to the arm about one-third of its length from the deck. This arrangement gives a considerable angle between the centerline of the arm in inboard position and the vertical through the pivoted point. This angle is the main determining factor in the power needed to move the davit out; thus the greater the angle, the greater the power required. There will always be a force in an inboard direction to be overcome, as long as the center of gravity of the system (boat and arm) is inboard of the pivoted point, and this force will effect a compression in the turning-out parts. The force to be overcome depends on the angle above referred to, the weight of the system, i. e., davit arms and boat, the length of the arm, and the direction and point of application of the parts for moving the davit out.

Under ordinary conditions the power needed for swinging the boat out is comparatively very great, even with the ship in an upright position. If the ship should take a list, and the passengers in a moment of panic should rush into the boat before it is launched, the power needed for turning out the boat would be so great that not enough men could find room to work the cranks to furnish the required power. There is usually room for only four men at each crank.

The possibilities of taking care of extra weight and possible list are so limited in this class of davits that they cannot be made dependable under extraordinary conditions, which, however, are not at all unlikely to prevail in case of disaster.

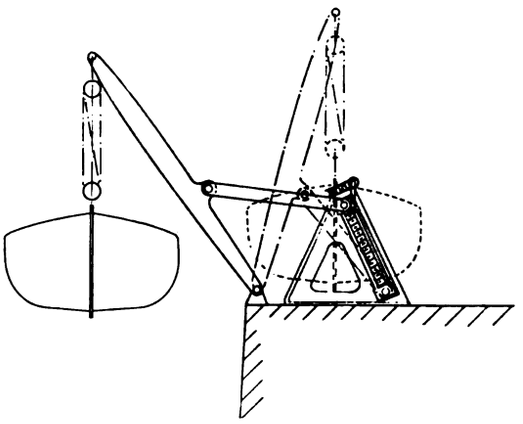

Fig. 8.—Broady-Lundin Link Screw Davit

Another serious objection to this class of davits is that they are, as a rule, very wobbly and unsteady. The arms are in most cases pivoted at their lower end, and have no other steadying support in their entire length. The necessarily non-rigid connection between the turning-out parts and the arm will not help at all to steady the arm; certainly not in the fore and aft direction and for twisting. The strain fore and aft is considerable, especially if the ship is pitching. All the davits must have an overhang in the fore and aft direction so that the boat will clear them when swung out. This overhang will, of course, cause a tremendous twist in the arms and also a strain tending to pull the arms together. The davits of this type will therefore be very unsteady unless they are made excessively heavy and very wide in a fore and aft direction at the pivoting point. This arrangement, of course, increases the weight and cost and also gives a very clumsy appearance.

A few davits of this class have been provided with guiding frames to steady the arms. The arm is in this case guided in a slot and slides against bare iron; this naturally helps to steady the arms, but the friction between the arms and the guides will be so great that the power necessary to launch a boat will have to be increased tremendously. It will very soon reach a point (especially on a pitching ship) where it is impossible to swing the boat out. This arrangement will also look very clumsy and add considerably to the cost of the davits.

Another objection to this class of davits is that they take too much deck space. The very long screw or link con-

* Continued from the June issue.

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nection makes it necessary to place its inboard support very far in. The deck space required for this class is therefore greater than for any other.

The vital part of a pivoted davit is the screw drive, of which there are two different types. One type is characterized by a swinging screw and the other by a rigidly supported screw. The screw in the first type is generally supported at its inboard end by either a swiveling or a stationary bearing in the deck frame, in which latter case it is provided with a universal joint between the deck frame and the threaded part. The screw actuates a nut connected to the davit arm. Only one end of the screw is thus supported, and the screw merely works in the nut. For working purposes there must always be a considerable clearance between the screw and the nut. This will give a very shaky and unsteady screw connection between deck frame and arm, as in most cases there are no other means provided for steadying this connection. This lack of rigidity is very dangerous when a boat is swung out, as the screw is subjected to compression during nearly the first half of the operation. The wear and tear of the screw connection will be very great, as the centerline of the screw and the nut will never coincide when under compression. The threads in the nut will therefore not afford any bearing surface for the screw, but will, on the other hand, cut the thread. To make it possible to turn the davits out, the threads are made comparatively fine. The wear and tear will therefore very quickly put a screw of this construction out of action, especially if all the boat drills required by the new laws are held.

Another danger is that as the screw is unsupported and entirely exposed when the davit is partly or fully swung out, the slightest blow from any direction will tend to bend the screw and thus put it out of commission. The screw is generally covered completely when the davit is in its inboard position, but as soon as the outboard movement of the davit begins the screw is automatically uncovered. The compression in the screw during the first half of the travel, owing to the loose construction, will be partly resolved into a force tending to bend the screw. Any outside blow will only tend to increase this ever-present difficulty, and it can easily be seen that an unprotected screw is very likely to be damaged by such a blow, especially from the lifeboat itself as it is swinging fore and aft. If this happens during the travel inboard of the boat, the serious results might not be noticed until the next time the boat is to be swung out. The length of the screw connection for a 26-foot to a 28-foot lifeboat is about 8 feet, and such a long connection increases the liability of damage even from the slightest blow.

The second type of screw drive is best illustrated by the link screw davits. The characteristics of these davits are that they have a strong, substantial link connection between the screw arm and the davit. The arms are generally of the same type as in all the others of this class, viz., their lower end is pivoted to brackets close to the side of the ship. The link is connected to the arm at about one-third of its height from the deck. The link is driven by means of a nut pivoted to its inboard end, which is worked by an actuating screw.

The screw connection in the link screw davits gives a very well protected and supported screw. The link takes up all the twist and bending of the arm. As the sliding nut moves on its substantial bearing surfaces in the frame, it relieves the screw from all side pressure. Only the forces along its centerline act on the screw, and it therefore works under the most favorable and effective conditions, and stands up very well.

Another favorable feature is that the link, during inboard position of the davit, is generally at right angles to the arm. The power needed to swing the davit out is therefore the minimum for this class—that is, the pivoted davit.

There are quite a number of different types of pivoted davits in the market. It is impossible to describe all of them, only a few can be briefly mentioned here.

One type of pivoted davit is the Broady davit, Patent No. 1,128,845. The main feature of this davit is the construction of the screw connection. A tube with an inside nut at its inboard end is connected to the arm. A screw, supported at its inboard end in a stationary bearing in the deck-frame, works in the inside nut in the tube. The screw is provided with an annular tubing which slides on the outside of the tube which carries the nut. The screw is provided with a universal joint between the deck frame and threaded part. When the screw device is worked the two sleeves or tubes work telescopically on each other. Thus there will always be a very rigid, well-protected screw connection. The bearing surfaces between the two working parts will at all times be very ample, especially when there is compression. The screw and the nut sleeve will never be out of line, and thus the screw will only have to act in an actuating and controlling capacity and will never be depended on to steady the connection; therefore there is no undue friction or wearing of the screw, due to the cutting action of the nut when not in perfect alinement. The screw is always protected by two strong tubes of large diameter. It will take a very hard blow to put this construction out of order. The serious objections generally found against the above-mentioned first type of screw drives are here fully overcome, but the disadvantages of the general principles remain.

The Broady-Lundin davit, Patent No. 1,105,594, is a link screw davit. This davit is characterized by its slanting screw, which is so arranged that when the davit is inboard the link is at right angles to the arm, and when the davit is outboard the link is horizontal. This construction requires much less power to operate in any direction than if the screw was placed in a horizontal position close to the deck. With the latter arrangement great power is required to swing the davits inboard, especially with a heavy boat hanging in them; this can be laid to the very unfavorable direction of the forces to bring the arm from an outboard position. A Broady-Lundin davit arrangement is shown in Fig. 8.

There have been some davits of Class D designed for big units of lifeboats; in some cases one set of davits had to take care of, say, five large 30-foot lifeboats. They were made of immense size and had therefore to be operated entirely by power. Davits of this type are large and cumbersome, the units too big, and the power uncertain in case of disaster. They must necessarily be heavily constructed and no doubt cost a good deal more than other davit arrangements. One set of davits in such a case must serve for many lifeboats, and the launching will necessarily go very slowly, as only one boat can be handled at a time. If one set of davits should be out of order, about 400 people would have to be taken care of in some other way. Something may very readily go wrong with the supply of power. Large power-driven units like these should only be used in extraordinary cases. The intention of the law-makers is very clearly shown in the stipulation of a minimum number of davits to take care of a minimum number of people. They have evidently decided that it is better to arrange for many easily operated smaller units than for a few big ones. The davits should be of such size and so arranged that they can be

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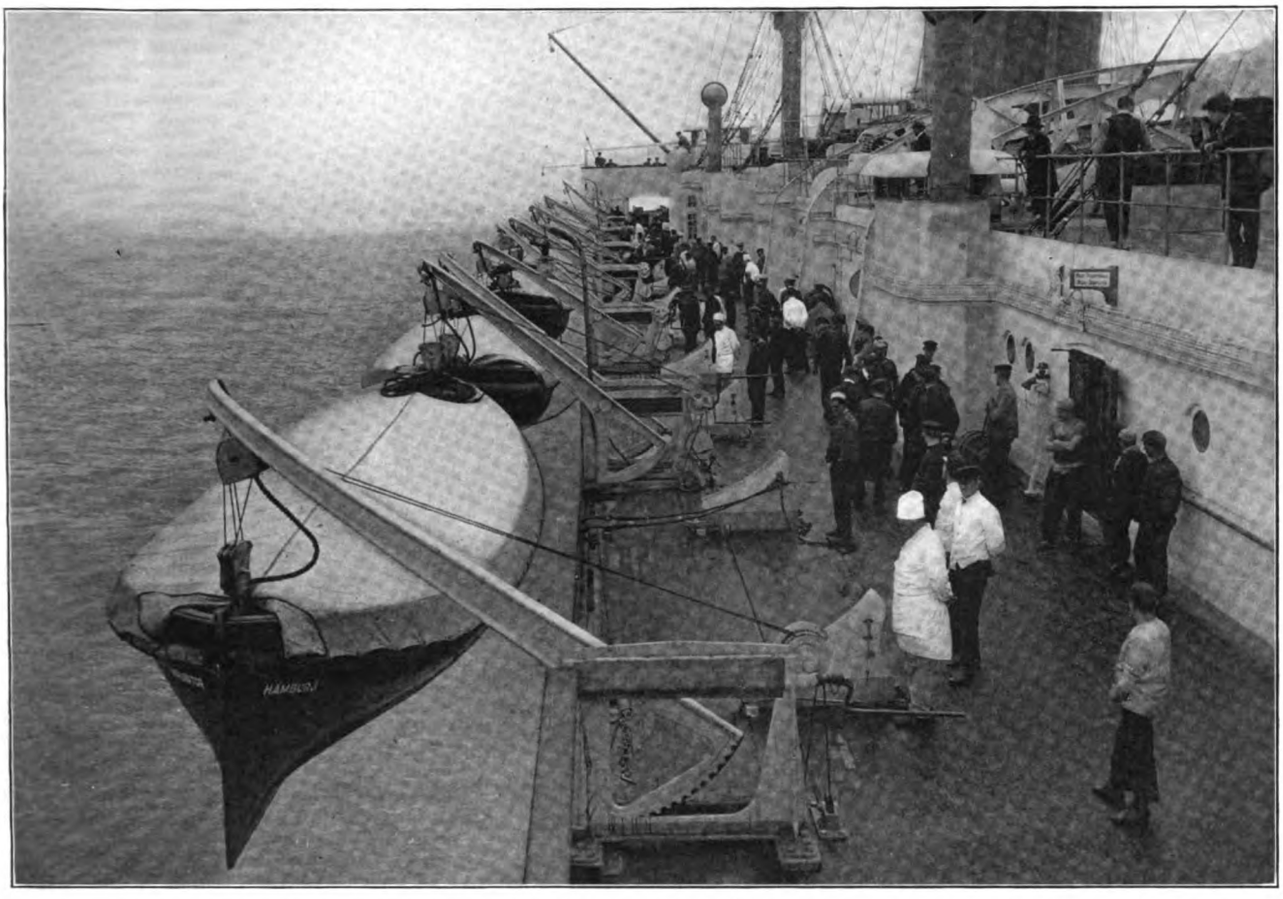

Fig. 9.—Boat Drill on the Hamburg-American Liner *Imperator*, Showing Welin Quadrant Davits, with Boats Swung Outboard

turned out by hand, this being the only certain way. Of course, arrangements for power drive could be made in addition to hand drive.

The link screw davit is necessarily very high in price, owing to the many operating parts, and it is therefore very seldom used.

Several types of pivoted davits are shown in Figs. 6, 7 and 8. The davit shown in Fig. 7 is of special interest as being of a rather unique construction. The frame is very substantial and an improvement over the ordinary pivoted davit. The arm is entirely supported by a nut on which it hangs. This nut is guided in a slot in the upper part of the frame and is actuated by a screw above the slot. The arm is held in position at its lower end by a freely moving link connection.

CLASS E DAVITS

There are only two different types of quadrant davits, Class E. One is the Welin quadrant davit, Patent No. 680,823, and the other is the Schmidt davit, Patent No. 795,937.

There are many thousand sets of Welin quadrant davits installed on board ships to-day, and their number far exceeds that of all the other mechanical davits taken together. The general appearance of this type is familiar to all seafaring men and to others interested in the davit question.

In general, the construction of the Welin quadrant davit may be described as follows: A substantial square-shaped and broad-flanged frame is bolted to the deck. The lower part of the frame is provided with a toothed rack and a slot. The upper part is provided with an actuating screw turning in stationary bearings. Above the screw there is a rigid bronze-sleeved guide bar of ample dimensions. A nut, actuated by the screw, travels on the guide bar. The screw, guide bar and rack are all parallel and athwartships. The shape of the arm has given the davit its name. The lower part is a quadrant, provided with teeth and a flange, and works in the rack and slot of the frame. The upper part of the arm is curved somewhat in a fore and aft direction, to give the required overhang. The center of the quadrant is provided with a hole for the pin on the traveling nut; this nut holds the arm in position and also swings the arm when the davits are operated by turning the screw. The arm is arranged so that in its inboard position the upper end, or center of eye, comes slightly inside of the center of the quadrant.

This construction is very rigid and substantial without unnecessary weight. The arm is firmly supported both at its lower edge and at about one-third of its height upward by means of the strong rigid frame. The twisting and bending of the arm is thus reduced to a minimum and will not in any way affect the working parts.

The power required to swing the boat out is absolutely the minimum, as can be seen from the following:

The quadrant rolls on the flange in the slot and is controlled in its position by the toothed rack. There is, therefore, only negligible rolling and gear friction to overcome in the lower part of the arm. The nut slides on the rigid guide bar, the ample dimensions of which insure a large bearing surface to take care of all the stresses through the arm and minimizes the friction. The center of the radius of the quadrant is always in the centerline of the guide bar. Thus there can be no side pressure whatsoever on the actuating screw. The actuating screw is only sub-

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jected to a thrust along its centerline, and can therefore be designed to give the best efficiency. It is generous in size, with large threads, the pitch always being so that it is self-locking, thus giving perfect control throughout the operation of the davit. Ample clearance can be given without detracting from its effectiveness. The actuating screw is very rigidly supported in the stationary bearings in the frame and also well protected from all blows by the upper part of the frame.

The very important working principle of the quadrant davit is that the force applied to the arm through the screw is always at right angles to the line between the center of the radius of the quadrant and the lower point of contact of the periphery of the quadrant with rack and slot. This will be the case in any position of the arm, and it is therefore generally called "the moving fulcrum" principle. The turning moment for the arm, under these conditions, will always be the maximum and always the same for all positions of the arm for the same amount of power applied.

Another feature helps to minimize the required power to swing the boat out: It is stated above that the hanging point of the arm (the eye), with the davit in the inboard position, is slightly inside of the center of the radius of the quadrant. Therefore, only a very short part of travel will require a very small outboard force; almost immediately the weight of the boat and arm will help the operation by changing the direction of the force in the screw. It is then only necessary to overcome all the friction, which is a very small matter.

The above shows why such a small amount of power is sufficient to launch even the largest lifeboats with the Welin quadrant davits; ordinarily only one man is needed at each crank. Even with a big list there will never be any uncertainty of action as far as turning out of the davits is concerned, as long as the list does not make it impossible for the men to stand on the deck to turn the cranks.

Another very important characteristic of the Welin quadrant davits is the compensation. By compensation is meant that the falls are led over sheaves so that the boat will get a more nearly horizontal path of travel than if the falls were led directly from the blocks to bollards or belaying pins. By this compensation, in some cases, a shorter arm than would otherwise be necessary may be used to give the proper clearance between boat and edge of deck, viz., with nested boats. Furthermore, the power required to swing the boats in is also reduced. From the following table can be seen the power needed on the crank to swing a lifeboat in or out, loaded and unloaded:

	Comparative Effort on Crank — Quadrant Lbs.	Pivoted Lbs.	Percentage
Boat in inboard position, empty...	8½	56½	Quadrant 15 percent of Pivoted.
Boat in inboard position, loaded..	23½	156	
Boat in outboard position, empty..	75	101	Quadrant 75 percent of Pivoted.
Boat in outboard position, loaded.	210	275	

Comparative figures are given for a Welin quadrant davit and a Broady pivoted davit. The same swing, outreach of davits and weights of boats are used. As nearly as possible the actual frictions and resistances for new davits are taken into consideration to give an absolutely fair comparison. The nature of the construction will to some extent affect the figures, such as the lesser rigidity of the pivoted davit. This cannot be accurately determined, but is none the less of great importance.

The open construction of the Welin quadrant davit is of great advantage in regard to upkeep and inspection; one can at a glance see if there is anything wrong with the driving mechanism. The question of the effect of ice on the operation of these davits has often come up. The only part where the ice could form on the davits in any quantity is in the rack, but it will never put the davit out of working order. The pressure of the sharp-edged flange and teeth will crush any ice because the pressure on the ice in the rack will be several thousand pounds per square inch. All the ice will press out or melt out of the rack. There are in a complete lifeboat and davit installation some parts that will much more readily be put out of order by ice than the davits. For instance, the necessary block and tackles. It is certainly safe to say that the davits would be the last parts of the whole equipment to be put out of commission by ice. This has been demonstrated many times in actual practice on board ships.

The deck space required for Welin quadrant davits is much less than for pivoted davits. The frames generally do not reach inboard further than about half the beam of the boat against at least the full beam for pivoted davits. The frames and arms are made of cast steel, as this requires less cost in upkeep, compared with structural steel davits. The weight will be practically the same for the same strength as for structural steel.

A very important question often comes up when discussing mechanical davits: How will the weight compare with the old round-bar davits? The shipowner naturally does not like to put more weight than absolutely necessary so high up on his ship. If we now take as an example a 24-foot 30-person metallic lifeboat, the weight of this boat and equipment is 2,250 pounds; 30 persons at 165 pounds is 4,950 pounds; tackle and blocks 125 pounds, giving a total of 7,325 pounds. The smallest overhang radius that could be considered for round-bar davits to take care of this boat is 5 feet 6 inches. If these values are used in formula (2) the diameter of the davits must be 6½ inches. If, now, the davits are 9 feet above the boat deck and reach down to the deck below, the weight will be for the davits and brackets about 5,300 pounds. If the turning gear is added, the total weight will be at least 6,500 pounds. For the same boat a set of Welin quadrant davits, size D, 5 feet 6 inches would be used, weight 1,750 pounds. The round-bar davits in this case weigh 4,750 pounds, or 3.7 times more than the Welin quadrant davits. In every case the Welin quadrant davits will be much lighter than round-bar davits when figured to comply with the new law. At the same time they will be much more substantial than any other class of davits, and by their very looks will inspire confidence among the passengers, which is of great importance in time of disaster.

Another important question to answer is: Is it necessary to reinforce so heavily the deck as to make the use of Welin quadrant davits prohibitive? With a fully loaded 24-foot, 30-person boat hanging in the swung-out arms of size D, 5-foot 6-inch davits, the deck structure will be subjected to the following stresses for 15 degrees list of the ship. The pressure at the outboard end of the davit frame is 10,300 pounds and can easily be taken care of by a 2-inch pipe stanchion, unless, as is generally the case, the deck is amply strong enough, when no additional support is necessary. The pull on the deck at the inboard end of the frame is 5,750 pounds and can be taken care of by a ¾-inch rod going through the deck. The pull can also be taken care of by plate or angle iron under the deck, secured to two adjoining deck beams. The extra reinforcements will in most cases not exceed 200 to 300 pounds for a set of davits and is absolutely negligible. Therefore the comparatively small weight of davits and reinforcement will be an extra inducement for the shipowners to adopt the Welin quadrant davits.

The Schmidt davit is a gravity davit of the quadrant

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class. There is no toothed rack or actuating screw on this davit. The arms are held in position at their lower end by two wire ropes going from each corner of the quadrant to opposite sides of the frame. The upper end of the arm is held by means of a rope leading to a drum on the frame over a sheave on top of a high stanchion on the inboard end of the frame. The two drums for one set of davits are worked simultaneously by means of a single shaft running between the davits. The quadrants roll in slots and are thus steadied sideways. The davits are placed in from the ends of the boat, thus eliminating the overhang of the arms. This, of course, brings the davit frames far inboard and the boats must be chocked exceedingly high above the deck. The davits are swung out by means of the force of gravity on the arms and the boats. This is not a safe proposition in the writer's opinion, as previously stated about gravity davits. It is therefore not deemed necessary to go into further details about this type of quadrant davits.

(To be concluded.)

Notes on the Conversion of Cargo Vessels into Bulk Oil Carriers—IV

BY F. K. RUPRECHT *

In the former case the vertical stiffeners will be bracketed to the tank top, and in the latter case they will be carried down and riveted to the floor plates and bracketed to them also (Fig. 9). The bulkhead will be continuous to the strip of plating on the centerline at the tank deck level where the stiffeners will be bracketed to the beams (Fig. 10). Above this the bulkhead extends to the upper deck, which forms the top of the expansion trunk. If the

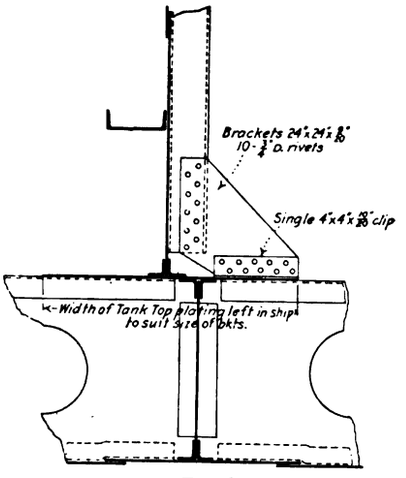

Fig. 9

tank deck is entirely removed this bulkhead and the stiffeners will be continuous to the upper deck. In this case extra stiffening is required, due to unsupported length of stiffeners.

The plating will be erected in horizontal strakes and the connection to the tank top will be by double angles, double zigzag riveted. The connection to the top and bottom of the shelf at the tank deck will be by double angles single riveted, and to the upper deck by angles of the same size. The butts and laps of the plating will be double riveted throughout. The horizontal stiffeners will be of the same size as those on the transverse bulkheads and will be bracketed to them as described in the following section.

* Associate Member Society of Naval Architects and Marine Engineers.

Aft in the way of the tunnel the centerline bulkhead will be built in three sections, one between the tank top and tunnel, or in some cases between the keel plate and tunnel. The second section will be from the top of the

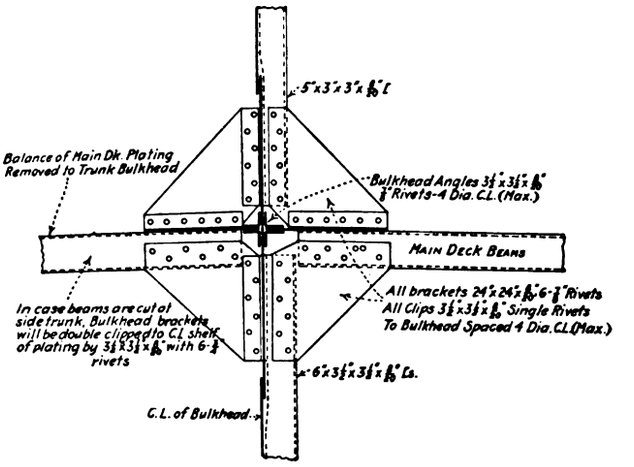
5"x3"x3"x⅝"ℓ
Balance of Main Dk. Plating Removed to Trunk Bulkhead
Bulkhead Angles 3½"x3½"x⅝"
¾" Rivets-4 Dia. C.L. (Max.)
Main Deck Beams
All brackets 24"x24"x⅝"-6-¾" Rivets
All Clips 3½"x3½"x⅝" Single Rivets
To Bulkhead Spaced 4 Dia. C.L. (Max.)
In case beams are cut at side trunk, Bulkhead brackets will be double clipped to C.L. shelf of plating by 3½"x3½"x⅝" with 6-¾" rivets
6"x3½"x3½"x⅝" Ls.
C.L. of Bulkhead.

Fig. 10

tunnel to the shelf at the tank deck level, and the third section will be between this and the top of the expansion trunk. The connection to the tunnel will be by double angles of the same size as the angles to the tank top. The vertical stiffeners will be cut at the top of the tunnel and will be bracketed to the same as described under "Tunnel."

Vertical web stiffeners will be fitted in line with the web frames at the ship's side. These will be flanged plates of the width and weight required by rule, and will be connected to the bulkhead by single angles, single or double riveted, according to size. The webs will be clipped to the strip of tank top plating and special brackets will be fitted that will have a double-riveted connection to the web plate and to the floor plate (Fig. 11).

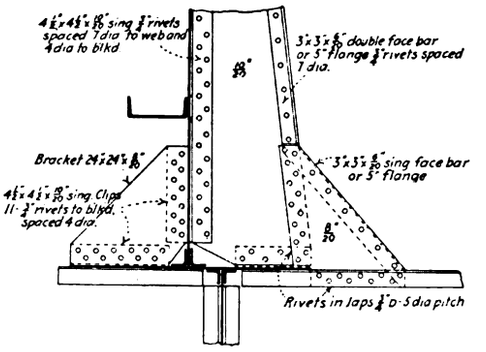
4½"x4½"x⅝" sing. ¾" rivets spaced 7 dia. to web and 4 dia to bkd
3"x3"x⅝" double face bar or 5" flange ¾" rivets spaced 7 dia.
Bracket 24"x24"x⅝"
3"x3"x⅝" sing face bar or 5" flange
4½"x4½"x⅝" sing. Clips 11-¾" rivets to bkd. Spaced 4 dia.
Rivets in laps ¾" D-5 dia pitch

Fig. 11

Aft, in the way of the shaft tunnel, the web will be cut and bracketed to the tunnel stiffeners. Under the tunnel the regular type brackets as fitted in line with all other vertical stiffeners will be worked.

Supporting brackets to the webs from the bulkhead will be fitted at convenient heights, usually at the same level as the horizontal girders, and will be single clipped to the bulkhead and web plate. These will hold the web square to its work when the bulkhead is subjected to pressure. The webs will be double riveted at the tank deck level to the strong beams, and a bracket will be fitted to secure a good connection to the beam. In the expansion trunk the web will be straight flanged plates of the same width

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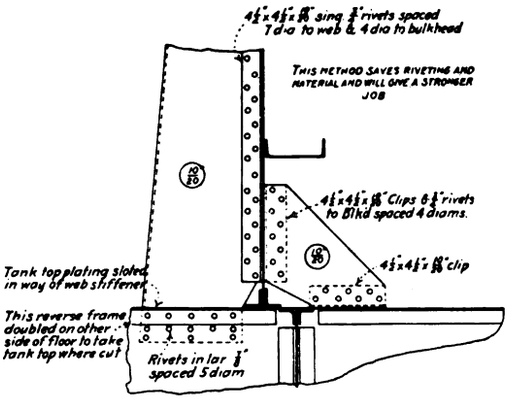
4½"x4½"x⅝" sing. ¾" rivets spaced 7 d-a to web & 4 dia to bulkhead
THIS METHOD SAVES RIVETING AND MATERIAL AND WILL GIVE A STRONGER JOB
4½"x4½"x⅝" Clips 6-¾" rivets to Blkd spaced 4 diams.
4½"x4½"x⅝" clip
Tank top plating slotted in way of web stiffener
This reverse frame doubled on other side of floor to take tank top where cut
Rivets in lar 1" spaced 5 diam

Fig. 12

as the top of the hold webs, and will be connected to the bulkhead in the same manner. They will be clipped to the strip of plating at the tank deck level and double riveted to the upper deck beam.

TRANSVERSE BULKHEADS

The plating and stiffeners of all transverse bulkheads will be according to rule. Since the centerline bulkhead will be continuous the transverse ones will be constructed accordingly. The old frame floor plate and deck beams will be removed and a bottom horizontal strake will be fitted from the centerline bulkhead to the bilge. This strake will be deep enough to carry it well above the tank top level. As mentioned under "Tank Top," a strip of plating will be left on the horizontal stiffener side of the bulkhead. Double shell bars will be used single riveted or one large, double zigzag riveted may be substituted. The angles to the decks, expansion trunk bulkheads and centerline bulkhead will be of the same size as the shell bars. All corners of the angles will be welded and joggled over the continuous angles of the centerline bulkhead. An angle of the shell bar size will be carried along the bulkhead and riveted to the tank top plate on the under side. This angle will be the continuation of the bulkhead bar on the centerline keelson and will be carried to the margin plate and then calked. A corresponding angle will be carried along the top side of this tank-top plate and will be joggled over the centerline bulkhead angle and carried up the bulkhead (Fig. 8). On the vertical stiffener side these two angles will be carried to the edge of the tank-top centerline plate only and calked. If only single angles are fitted on the bulkheads, only the former remark applies. In newly constructed tank vessels single bulkhead bars are very often fitted, but in a conversion job it would be very difficult to secure oiltight work unless double bars are fitted.

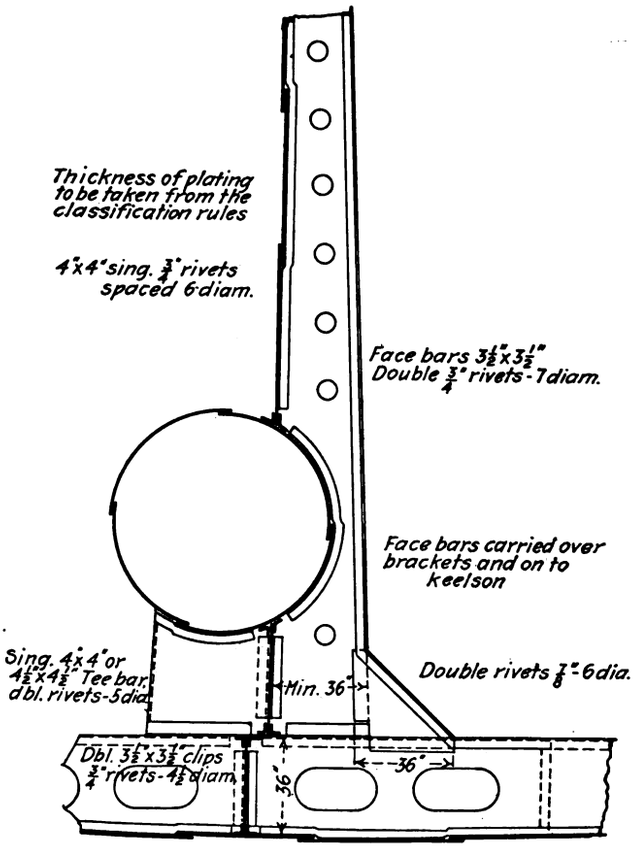
Thickness of plating to be taken from the classification rules
4"x4" sing. ¾" rivets spaced 6 diam.
Face bars 3½"x3½" Double ¾" rivets - 7 diam.
Face bars carried over brackets and on to keelson
Sing. 4"x4" or 4½"x4½" Tee bar dbl. rivets - 5 dia.
Min. 36"
Double rivets ⅞" - 6 dia.
Dbl. 3½"x3½" clips ¾" rivets - 4½ diam.
36"
36"

Fig. 13

The plating can be arranged in three ways: First, all strakes erected horizontally; second, all strakes arranged vertically; third, a combination of the first and second method. The latter is clearly the cheapest and the best arrangement seems to be as follows: A horizontal strake from the centerline to the bilge; this plate will be wide enough to take the angles at the tank top and to take the bilge radius. A vertical strake at the ship's side from the tank deck to the bottom strake. This means that only two plates have to be templated. The rest of the plates

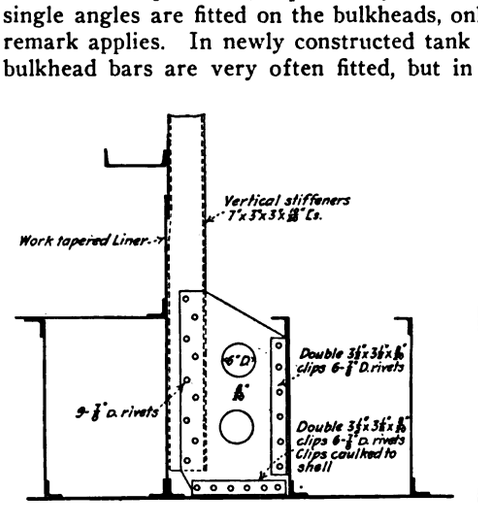
Vertical stiffeners 7"x3"x⅜" Lo.
Work tapered Liner
Double 3½"x3½"x⅜" clips 6-⅞" D. rivets
9-⅞" D. rivets
Double 3½"x3½"x⅜" clips 6-⅞" D. rivets Clips caulked to shell

Fig. 14

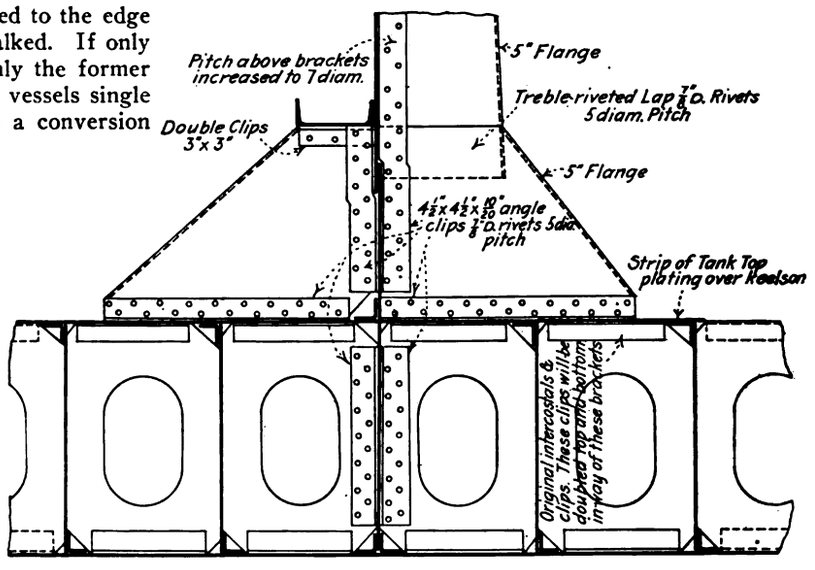
Pitch above brackets increased to 7 diam.
5" Flange
Treble-riveted Lap ⅞" D. Rivets 5 diam. Pitch
Double Clips 3"x3"
5" Flange
4½"x4½"x⅝" angle clips ⅞" D. rivets 5 dia. pitch
Strip of Tank Top plating over keelson
Original intercostals & clips. These clips will be doubled top and bottom in way of these brackets

Fig. 15

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will be arranged vertically to the tank deck level (Fig. 8). In the expansion trunk vertical strakes will be fitted between tank and upper deck. All butts and laps will be double chain riveted throughout and will be kept clear of all vertical and horizontal stiffeners to allow calking. The horizontal stiffened side will be the calking side.

The vertical stiffeners will be of bulb channel or Z-section, spaced about two feet apart, but they will be arranged so that a stiffener will be in line with each keelson. The stiffeners will be bracketed at the bottom to the outside plating and to the next floor plate by special brackets (Fig. 14).

In line with the side keelsons, vertical web stiffeners will be fitted. These will be flanged plates of the weight and width required by the registration societies rule. They will be connected to the bulkhead by a single angle, single or double riveted as required and clipped by single double riveted clips to the strip of tank-top plating over the keelson. A bracket will be fitted between the web and tank-top plating of a size sufficient to make the total length of connection two frame spaces. At the top the webs will be clipped to the tank deck and supporting brackets fitted at horizontal girder heights, as described under "Centerline Bulkhead" (Fig. 15).

The upper ends of the stiffeners will be bracketed to the strip of plating at the tank-top level. In the expansion trunk the verticals will be of the same section and will be bracketed at the tank deck level and to the upper deck beams.

If the wing spaces between the tank and the upper decks are to be used as summer tanks, transverse bulkheads will be built on the same frames as the main cargo bulkheads. The plating and stiffeners will be the same as the bulkheads in the expansion trunk. If these spaces are to be used for coal bunkers, only one bulkhead will be installed besides the cofferdam bulkheads (Fig. 3). The cofferdam bulkheads, however, will be built continuous from bottom plating to the upper deck, since the tank deck will be removed in them.

Horizontal stiffeners will be fitted to all bulkheads at the stringer levels. These may be built-up girders consisting of an angle riveted to the bulkhead, a wide plate and a heavy face angle. A cheaper way, and better from certain points of view, is to fit a large channel or I-bar instead of the more complicated built-up stiffener. The only disadvantage is that in some cases it is desirable to fit all the stiffeners on one side of the bulkhead, and while the girder plate can be cut out in way of the verticals, it would be impossible to fit channel stiffeners. The smaller amount of riveting needed with the channel or I-sections, cuts the expense for each bulkhead by a considerable amount. These sections can be made unlimited in strength by fitting face plates to the I-beams and reverse bars in the channels.

The horizontal stiffeners will be bracketed to the stringers by heavy flanged brackets three frame spaces in length by two frame spaces in width. They will be double riveted to both stringer plates and bulkhead stiffeners, and the shell clips to stringers will be doubled for three frame spaces each side of the bulkhead. On the vertical stiffener side the brackets will be double clipped to the bulkhead, single clipped and double riveted, and the vertical stiffeners will be worked intercostal and bracketed to the bracket plate.

At the centerline bulkhead brackets two frame spaces each way will be fitted at the horizontal stiffener levels. On one side the brackets will be double riveted to stiffeners and on the other will be double clipped, or single clipped and double riveted, to the bulkhead. The vertical stiffeners will be continuous and the brackets will be cut out to allow them to pass through; this means that the bulkhead clips will be fitted intercostal. All these clips will be calked oiltight.

(*To be continued.*)

Japanese Liner Fushimi Maru

Those who have followed the development of naval architecture and marine engineering in Japan cannot fail to appreciate the efforts put forth by the Nippon Yusen Kaisha (Japan Mail Steamship Company) and the Mitsu Bishi Dockyard & Engine Works. The former, aided largely by Japanese Government subsidies, is the largest shipowner in the Orient. Moreover, important technical researches are constantly being carried out by its staff of expert engineers. The latter is a private concern owned by Baron Iwasaki's family, whose immense wealth has enabled the yard to reach a high state of perfection in both its organization and equipment, so that it is now capable of building the largest ocean liners as well as super-dreadnoughts.

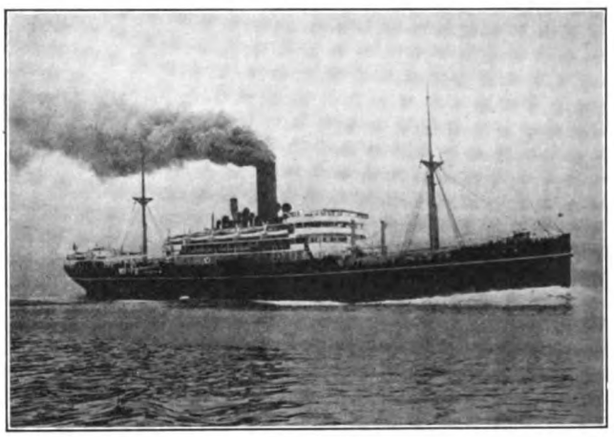

Fig. 1.—S. S. *Fushimi Maru*

The latest product of these two concerns is the steamship *Fushimi Maru,* a twin screw full scantling steamer having the following dimensions:

Length overall	525 feet
Length between perpendiculars	505 feet
Breadth	63 feet 6 inches
Depth	37 feet 6 inches
Displacement	21,500 tons
Gross tonnage	11,000 tons
Deadweight capacity	13,000 tons
Measurement capacity	14,000 tons
Maximum speed	17 knots

As will be seen from the general arrangement plans, the *Fushimi Maru* has two complete decks extending from end to end of the ship. There is a continuous cellular double bottom extending from the collision bulkhead to the after peak bulkhead. The hull is divided into ten compartments by eight extra strong watertight bulkheads. The framing is especially strengthened according to N. Y. K. practice, which is to adopt heavier scantlings than usual requirements, especially in way of the boiler room and hatch openings. The 'tween deck framing is also stiffened.

The promenade deck and the upper deck amidships serve as the first class accommodation for 122 passengers, having rooms en suite and many spacious staterooms fitted with single berths. The first class dining saloon is situ-

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ated on the bridge deck and provides 20 tables comfortably arranged under a large oval-shaped dome skylight. Near the saloon is a roomy pantry. The social hall and smoking room are on the promenade deck. The decorative scheme applied to the dining saloon, social hall and smoking room is one of the most attractive features, as this vessel is the only liner which has adopted the style of Japanese decoration that prevailed 400 years ago in the period known in Japan as "the age of Fushimi and Momoyama." A children's room, a bar room, a swimming tank, a dark room for amateur photographers, a laundry, a barber shop and all other rooms necessary for comfort on a long voyage are also provided.

The second class accommodation is situated in the poop for 60 passengers. The dining saloon is plainly yet neatly finished, and the smoking room is located on the poop deck, which affords ample promenade space. On the upper deck aft there are compartments for 12 intermediate and 190 steerage passengers. The captain's and officers' rooms are situated on the boat deck.

The vessel is equipped with wireless telegraph and fire extinguishers and a thorough equipment of electric lamps, electric fans, telephones and ventilators. Among other features are a disinfection apparatus, a refrigerating installation and a hospital and operating room, all complete; the fresh water is purified by a Buhring's filter.

There are sixteen boats, twelve of which are lifeboats placed under Welin patent boat davits. As to cargo handling for the six cargo holds aggregating 14,000 tons measurement capacity, there are fourteen powerful winches in addition to a special heavy derrick which allows taking a load of 40 tons. The cargo handling gear provided enables rapid loading and discharging of the ship's cargo.

The main machinery, which develops 12,000 indicated horsepower, consists of two sets of triple expansion engines designed and constructed by the Mitsu Bishi Engine Works. A novel feature of the engines is the use of cast steel supports. The condensing system is of the contraflow type, in which the vacuum can be adjusted according to the varying temperatures of the sea water, and in which all exhaust steam is utilized to its highest degree of efficiency. Unusually heavy coverings are placed on the steam piping and valve boxes in order to reduce the heat loss through radiation, and thence the consumption of fuel to a minimum. The steam is generated by seven Scotch boilers working at 200 pounds per square inch, fitted with Howden forced draft.

The vessel was launched on June 28, 1914, the keel having been laid on May 19, 1913. She was completed on November 23, 1914. The hull and machinery, including the auxiliaries, were all constructed by the Mitsu Bishi Company, except the ash ejectors and forced draft apparatus, which are of foreign patents.

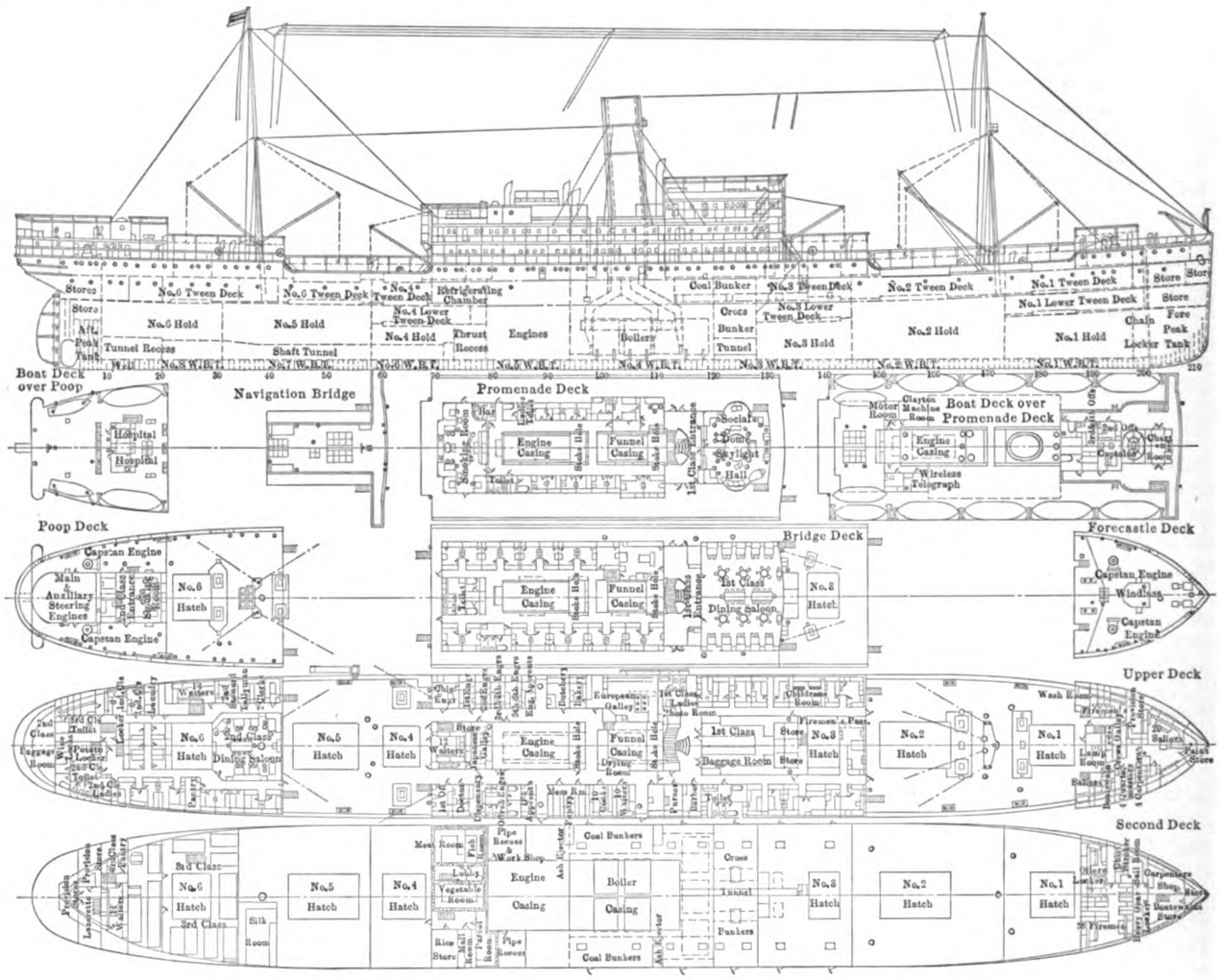

Fig. 2.—Profile and Deck Plans of S. S. *Fushimi Maru*

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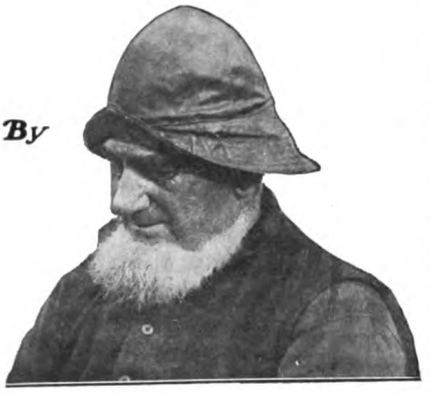
Economy Talks By "Old Scotch"



A Marine Engineer's "Paradise"

Well, boys! I have found her at last! She came right here to this port, and she's a beauty, too!

Oh, no! I'm not talking about girls, as I'm too old to be noticing petticoats. What I mean is that I've found the engineer's paradise. I've been preaching economy to you marine engineers for nearly a year, and now I've found the real thing in the economy line. The rewards of economy are comfort for the boys in the engine and fire-rooms, and this new creature which combines both comfort and economy is the *Northern Pacific,* now running between San Francisco and Portland.

Did you ever think in your wildest dreams that steamships would be racing express trains? Well, this ship and her sister are doing that same thing, and the best of it is that the steamers are beating the smoke wagons on shore. Think of scooting along 23½ knots, day in and day out, without anybody down below sweating over it, and you will not wonder that I call these clippers "paradises."

Think of a chief engineer having a cabin about 15 feet square all to himself, and a private bath on the side wherein he can wash up forty times a day, if necessary. Beats that galvanized iron bucket in the southwest corner of the fireroom that I used to have in my younger days, eh?

I don't believe any shipyard in the whole bloomin' country ever turned out any finer specimens of their art than these two packets. Although 524 feet long overall and lean in their lines, their 63 feet of beam gives plenty of room for everything. On these dimensions their gross tonnage is only 8,255, so you see that they must have pretty fine lines to hike along the way they do. As they can carry 856 passengers and 2,100 tons of freight, it would take a number of trains on the railroad to outcarry these boats. Every imaginable comfort for the passengers is provided, and it is just about as much trouble to travel between these two ports now as it would be to hire a room and sit around the St. Francis or the Waldorf hotels for a day or so.

Ah! but it's down in the engine and firerooms where the real comfort is found for the workingman. As you walk down the engine room ladder you might think you were going into an immense "rathskellar" (that's German for a liquid fuel station). The high-pressure turbine drives the central shaft and two low-pressure turbines drive the wing shafts. They look like three immense tins for holding the brown fluid. Talk about room to swing a cat by the tail! Well, there's room enough in those engine rooms to swing a camel by the tail; that is, providing his tail wouldn't break off while you were swinging him.

The first thing that strikes you is the simplicity of everything. I don't see how it would be possible to arrange marine machinery with less valves, pipes and other things than you find here. The wrought steel exhaust pipes look big enough to drive a Ford through them without touching the sides and tops.

The shaft alley is big enough to hold a Democratic convention in, and the strangest thing that strikes an old-timer like me is the size of the three main shafts. Just think of steel shafts only 12¼ inches in diameter to transmit over 7,500 horsepower each! They look like lead pencils compared with the shafts for reciprocating engines of that power. All the oiling is done by forced lubrication, and that extends to a new wrinkle for oiling the stern tubes. They force a special oil into the tubes under a pressure just sufficient to overcome the pressure of the water outside. This reduces the friction and saves the lignum-vitæ. I suppose the next thing they will be doing is to oil the skin of the ship so she'll slide through the water easier.

Firing on this ship is a "cinch," if there ever was one at sea. She has twelve watertube, oil-burning boilers of a new type, built by the Babcock & Wilcox Company. Two-inch tubes are used, so they can be cleaned quite readily with a turbine cleaner. The boilers are operated on the closed fireroom system of forced draft with mechanical atomization oil burners. The air is admitted both at the bottoms of the boilers and in the fronts, so that correct combustion is a matter of easy regulation. Although there are twelve boilers in the ship, they can maintain their scheduled speed on ten, leaving two dead, so that they can be cleaned when necessary during the voyage.

When I first began these papers I dwelt at length on the economy in reducing smoke and keeping the CO_2 regulated. I was, therefore, glad to see at least one vessel where they make arrangements to have the men in charge of the fireroom pay attention to these important items. By a very ingenious device the fireman can tell at a glance the density of the smoke passing up the stacks, and also get a fair approximation of the percentage of CO_2 in the waste gases.

As these ships run in competition with the railroad, they have to keep going on a regular schedule, and a lively one at that. They are only in port at each end of the run for about nineteen hours at a time. I am informed that they are averaging 8,600 knots a month, which is some running, believe me. I doubt if any steamers in the world are making any better mileage than that.

I wish I was a young man starting in to go to sea again. I would surely apply for a job on one of these flyers, where a man could take an interest in running these paradises of the Pacific.

Yours for economy,

Old Scotch

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Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding will be Answered in this Department

CONDUCTED BY H. A. EVERETT *

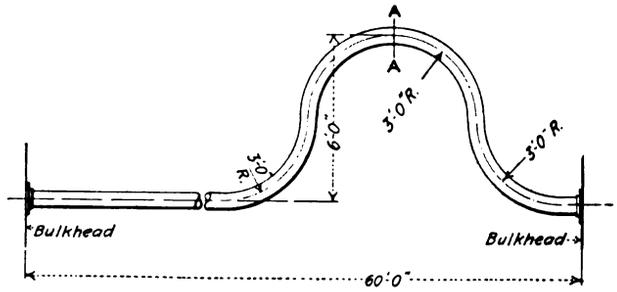
This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so. Indicator cards taken from marine engines will be carefully analyzed, the defects pointed out, and the horsepower calculated, provided complete data are sent with the cards.

Stresses in Expansion Bends of Steam Lines

Q.—Will you kindly inform me through your Query Department how to figure the stresses in expansion bends of steam lines? To take a specific case, I inclose a sketch of a 6-inch steam pipe, ¼ inch thick, subject to a steam pressure of 180 pounds per suare inch. R. P. S.

A.—An exact solution is involved and difficult and probbably not worth the time required when a result, sufficiently accurate for general engineering work, can be obtained by the following approximate method.

There should be borne in mind, however, the assumptions made in the solution. The pipe has a straight length of about 60 feet — 12 feet = 48 feet, which expands along its



Seamless Drawn Steel Pipe, 6 Inches Inside Diameter, ¼ Inch thick, Steam Pressure 180 Pounds per Square Inch

axis when heated by the steam. If the room temperature is assumed to be 70 degrees F., then the increase in the temperature of the pipe, when carrying steam at 180 pounds gage and 380 degrees temperature, is 380 — 70 = 310 degrees. The coefficient of expansion for a steel pipe of this character is customarily taken as .0000065 per degree difference of temperature, so that the straight pipe will increase in length $48 \times 12 \times .0000065 \times 310 = 1.61$ inches. This increase in length must be taken up by the expansion bend and corresponds to the deflection which that bend would be subjected to.

The character of the bend shown is such that each quadrant would take up one-fourth of the total movement. Therefore, considering the semi-circular section at the middle, this could be figured in a manner similar to the customary calculation for a hook. This semi-circular bend has a deformation of $\frac{1.16}{2} = .58$ inch. From tests which were carried out upon actual pipes of this sort to determine the loads required to produce certain deflections ("Steam Boilers," Peabody and Miller, 1908, p. 293), it is possible to predict the load in consonance with this deflection. This is (pipe No. 2) 2,290 pounds at 5 feet from the apex of the bend or 3,815 pounds at 3 feet from the top. Consider a section at the top of the bend (A-A), the bending moment about this section will be $3,815 \times 3 = 11,445$ foot-pounds and the stress due to bending will be

$$F = \frac{M\,y}{I} = \frac{11,445 \times 12 \times 3.25}{24.1} = 18,500 \text{ lbs. per sq. in.}$$

The direct stress is

$$\frac{\text{load}}{\text{Section A}} = \frac{3,815}{5} = 765 \text{ lbs. per sq. in.}$$

The total stress then is 18,500 + 765 = 19,270 (approximate).

It should be noted that if the character of the bend or its juncture with the main steam line differ appreciably from the sketch, the details of the solution differ accordingly.

Strength of Main Steam Pipe

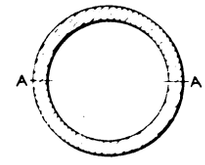
Q.—How do you calculate the strength of a main steam pipe? L. D.

A.—The calculation is made considering the pipe as a thin hollow cylinder. If we take a section of the pipe one inch long and let

P = pressure in pounds per square inch.
D = diameter in inches.
t = thickness of the pipe wall in inches.
f = fiber stress in pounds per square inch,

then $P \times D$ is the load tending to separate one-half of this ring from the other and split the pipe along a longitudinal element. This is resisted by the two strips of pipe at A and A, which together have an area = $2t$, therefore

$$f = \frac{P \times D}{2t}.$$



Section of Pipe

Pressure Oil Burners

Q.—Will you kindly explain to me a few of the most used pressure oil burners for naval purposes. I am especially interested in the Peabody burner and would be obliged if you can give some sectional drawing of it. NAVAL ENGINEER OFFICER.

A.—The commonest oil burners of the pressure type used in this country are the Thornycroft, Normand, Schutte-Koerting, Peabody and Fore River. Abroad the Kermode, Wallsend and Mejani are also common. All produce atomization mechanically by having the oil discharged from the burner under high pressure (about 200 pounds per square inch) and at a high temperature. The draft is customarily on a closed stokehold system and the amount of air used is regulated either by varying the pressure in the stokehold or by varying the size of the air admission holes. If natural draft be used, this latter is the only means available for regulating the air supply. In order to properly control combustion, powerful fans are

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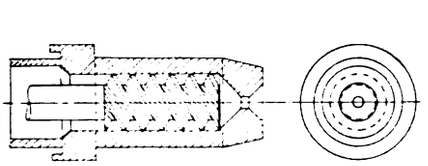

Fig. 1.—Schütte-Koerting

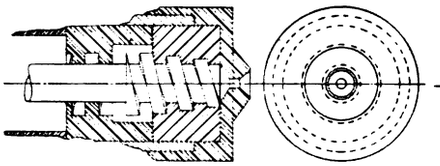

Fig. 2.—Thornycroft

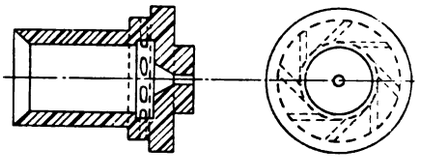

Fig. 3.—Normand

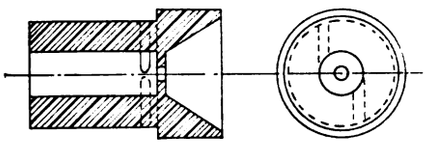

Fig. 4.—Fore River

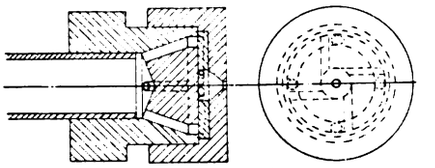

Fig. 5.—Peabody

Sketches Showing Characteristics of Atomizing Ends of the Principal Makes of Oil Burners

used which should be built to give a range of air pressure in the stokehold of from 3 to 4 inches. The oil fed to the burners is capable of regulations both by variation of the pressure and adjustment of individual burners, but the former is preferred, as it results in a simpler burner. The

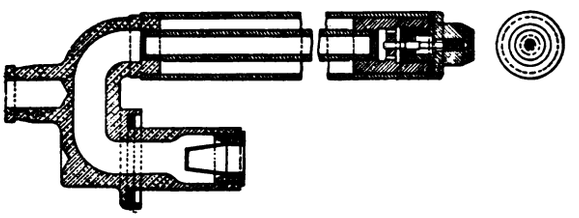

Fig. 6.—Schütte Koerting Burner

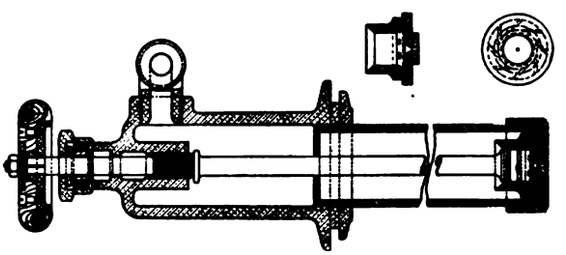

Fig. 7.—Normand Burner

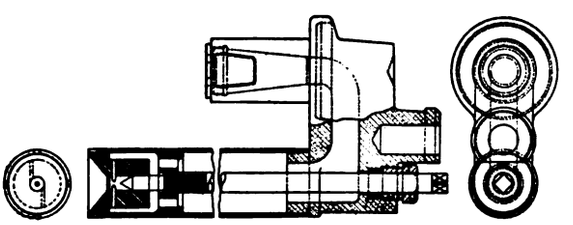

FIG. 36.

Fig. 8.—Fore River Burner

shutting down of a portion of the burners, if the air pressure regulation is insufficient, is easier than to attempt individual regulation. At present all burners of the pressure type force the oil through the burner through internal channels such that it has a rapid whirling motion close to the point of exit and is discharged in a fine conical spray. There are two methods of giving the oil this whirling motion previous to exit; first by using a passage of helical form, and, second, by delivering to a central chamber, close to the exit, by means of ducts which enter tangentially.

Examples of this first sort are shown in the sketches (Figs. 1 and 2) of burner tips of the Schutte-Koerting and Thornycroft burners, and of the second type in the

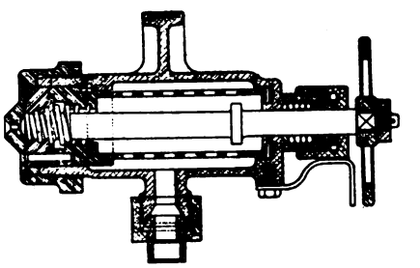

Fig. 9.—Thornycroft Burner

sketches of the Normand, Fore River and Peabody burners (Figs. 3, 4 and 5). These sketches give the fundamental differences of the various types. Figs. 6, 7, 8 and 9 show small views of the assembled burners.*

Slip of Screw Propeller

Q.—In the ship ..... the revolutions per minute average about 78. She has a wheel which is 14½ feet diameter and 15 feet pitch, and makes a speed of about 10 knots. What is the slip of the screw? C.

A.—The apparent slip is

$$\frac{\text{Pitch} \times \text{R. P. M.} - \text{speed in ft. per min.}}{\text{pitch} \times \text{R. P. M.}} = \frac{15 \times 78 - \frac{6080 \times 10}{60}}{15 \times 78}$$

$$= .134 \text{ or about } 13\tfrac{1}{2} \text{ percent.}$$

Spacing of Spring Bearings

Q.—What is the rule for the proper spacing of the spring bearings along the tunnel shafting? M. T.

A.—Assuming an allowable deflection between bearings of a constant amount per foot of length, the distance between bearings is, for solid shafts, a function of the 2/3 power of the diameter of the shaft. The following rule gives results in accordance with good practice:

$$L = KD^{2/3}$$

where L = length between centers of bearings in feet. D = external diameter of shaft in inches. K = 2.5 to 3.5.

* From "Developments in Oil Burning," by E. H. Peabody in the Transactions of the Society of Naval Architects and Marine Engineers for 1912.

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Letters from Marine Engineers

Discussion of the Design and Handling of Marine Engines, Boilers and Auxiliaries—Breakdowns at Sea and Repairs

This department is open to all readers of the magazine for the discussion of affairs in the engine room. All letters published are paid for at regular rates. Your ideas or experiences will be mutually helpful and interesting to other engineers. Write your letter now.

Some Defects and Remedies of Marine Diesel Motors*

Marine engineers the world over are a very conservative lot, and consequently the introduction of Diesel engines for the propulsion of vessels was looked upon with more or less disfavor. Although each new account of trouble with the motors seemed to justify this conservatism, nevertheless it was only natural to expect considerable trouble with the early ships. The change from the old reliable steam to oil motors was very great and somewhat in the nature of an experiment. Great strides have been made, however, during the last year or two. Many of the weak points of the early motors have been eliminated and great improvements have been made both in the design and construction of the various motors built, so that they now compare favorably with the steam engine. At the same time, the men who run these engines must be enthusiasts, not afraid of either dirt or work, both of which they will get in good measure.

It is the writer's intention to chronicle a few of the defects and breakdowns of one of the first large motor vessels, and how these have been successfully overcome, so that now we can cross the Atlantic in stormy wintry weather without a stop for any adjustment. The vessel has a deadweight capacity of 6,500 tons and is propelled by two single-acting four-cycle engines of six cylinders each, of the open type. The vessel has run approximately 120,000 miles since she went into commission nearly three years ago.

The motors are built with the back columns of cast iron, which simply take up the guide strain. These are not bolted to the cylinders, but are left slightly free of same. Steel columns which take up the whole stress of working are fitted as closely to the centerline of the engine as possible. The cylinders are secured to these. Steel diagonal tie rods are also fitted from the foundation plate to the bottoms of the cylinders, which stop any tendency of side play. This arrangement makes a light and very open engine.

The cylinders and head are cast in one piece and dropped into a frame with a fitting strip top and bottom, the rest being left clear for water circulation. On the bottom of the cylinder is bolted an extension piece bored true with it by means of which the piston can be lowered for cleaning or examination, and if necessary new rings can be fitted without disturbing any pipes, levers or high-pressure joints. This results in a great saving of time—in fact, the whole operation of examining, etc., takes less than an hour. We became quite adept at this work during the first few months we were on this vessel, as the pistons were connected to the rods by four 1¼-inch tap bolts which were continually breaking. Nickel steel was tried, but while this did not break, the material stretched. The consequent hammering of the piston on the rod did not conduce to a quiet working engine. On one occasion, when we stopped to examine, we found two of the bolts broken, the remaining two beieng nearly ½ inch slack. Other methods were tried, but with no success. Then new pistons were supplied with a flange cast on the under side and through bolts were fitted to the piston rod, which cured the trouble.

In the original design of water cooling for the pistons, telescopic pipes of steel were fastened to the bottoms of the pistons working into a larger sized outer pipe through stuffing boxes and glands. These steel pipes corroded very quickly with the action of the water, as it was then impossible to keep the glands tight. They were replaced by pipes of brass which worked fairly well, but on account of the slack piston trouble, they broke off at the neck frequently. Finally they were thrown out and the present system installed, which consists of a small jet of water forced up into the piston, the telescopic pipes having no rubbing parts, simply working up and down with the piston to prevent the water splashing.

It was also found after running a short time that the cylinder water cooling was not as it should be. The back part of the head was very hot, while the front was quite cold. Of course, no metal could stand that strain long and several of the heads were cracked. The trouble was that the head valves were crowded together too closely and the water being unable to get from one side to the other would lay stagnant. This was remedied by fixing a pipe to the back part of the head and discharging separately. With the new design of cylinder, which the builders of this type of engine are now using, the valves are placed well apart, giving a free passage for the water.

All of the water cooling is done by means of salt water. After a short trial running with sea water, the fresh water arrangement originally installed was cut out and nothing detrimental has been found up to the present time. No incrustation or salting up has taken place. This is a very important matter, as working with fresh water means that a large quantity of fresh water must be carried to make up for the inevitable loss. By using sea water a considerable amount of piping, etc., is eliminated.

With the motor proper, the exhaust valves are a rather weak part. These are of the ordinary mushroom type and if allowed to become overheated are apt to break and drop on top of the piston. The inlet air valve opens at the moment the piston is at the top of its stroke, so the inevitable happens and the inlet valve spindle is bent. Of course a full set of valves and chests are carried as spares, so it is quite a simple matter to replace them. At the same time it is not advisable to run too long without overhauling the exhaust valves. We find it best to take them adrift after each voyage in order to clean and grind them.

* This letter is from the chief engineer of the motor tank ship *Emanuel Nobel*, owned by the Société Anonyme d'Arment d'Industrie et de Commerce of Antwerp, and under charter to the Sun Oil Company, of Marcus Hook, Pa., for transporting oil from Philadelphia, Pa., to Rouen, France. The vessel is 390 feet 6 inches long, 51 feet beam, 29 feet molded depth, with a displacement of 9,000 tons and a deadweight carrying capacity of 6,500 tons, including 350 tons fuel, 30 tons stores, 100 tons water and 40 tons drinking water. Propulsion is by twin screws actuated by two 6-cylinder Werkspoor, direct-reversible, single-acting, four-cycle Diesel engines of 22-inch bore and 39⅜-inch stroke, each developing 1,325 indicated horsepower at 105 revolutions per minute. The vessel was built in 1913 by the Netherlands Shipbuilding Company of Amsterdam, and the contributor of this letter has been in continuous service as chief engineer of the vessel since she went into commission.—THE EDITOR.

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The only time the fuel valves give trouble is when dirt gets in with the oil, which gradually chokes the small holes in the diaphragm. This is soon noticed by the exhaust becoming smoky and the injection air pressure tending to rise. It is best when this happens to stop and overhaul, as if the trouble goes on too long it is apt to burn the end of the fuel chest.

One of the most interesting breakdowns I think we have had was when the intermediate- and high-pressure compressor cylinders were smashed up. These are of the tandem type, with the low-pressure on top and the intermediate- and high-pressure below, the latter pistons and rods being all in one piece and driven by balance levers from the main motor. The high-pressure piston had seized in the chamber, causing a complete smash. Both cylinders and pistons were broken and driven across the platform, bending and breaking the steel air and water pipe connections. The heavy steel crosshead was also slightly bent and the driving links were elongated nearly ¼ inch.

This happened at 3 A. M. and the oiler, who was standing close by, promptly bolted on deck out of harm's way. We commenced at once to fit the spare cylinders and put everything in order. The steel pipes caused the greatest trouble, but after forty hours' continuous work we had the satisfaction of getting under way and working both motors to our destination.

Another bad smash was the breaking of the large wheel of the half-time cam shaft gear. This is worked by a small cog wheel secured on the main crankshaft geared into a wheel of double its diameter fitted on a small crankshaft, being connected with suitable rods to another small crankshaft operating the cams, which revolves at half the speed of main shaft. A piece of metal had dropped into the teeth, breaking the large wheel, bending the small crankshaft and breaking its bearing bracket.

This was a most serious breakdown, since, although we had a spare wheel on board, the necessity of straightening the crankshaft was a big order. Moreover, every part had to come in exact, otherwise the timing of the valves would be wrong. In fact, it looked so formidable that we gave it up as a bad job. Eventually, however, we made a start and as we proceeded we found that it was not quite so difficult as we had imagined, and after thirty-five hours' hard work in a heavy rolling ship, we got the motor started up again. All worked well—in fact, the job was done so well that it was not found advisable to touch anything on arrival in port, and it continues to work as well as it did before the accident.

It should be pointed out that neither of these breakdowns had anything to do with either the design or construction of the motors. The first was the fault of the lubrication and the second was due to the carelessness of the engineer on watch. Otherwise, the only trouble we ever have with the whole of the compressing plant is occasionally the breaking of a suction valve in the intermediate-pressure cylinder, which is renewed in a few minutes. As the whole is driven by the motors, it is a very compact and simple plant.

For starting the motors, compressed air, of course, is used, at a pressure of 270 pounds per square inch, the fuel being injected into the cylinders at 900 pounds per square inch, so that all joints and piping must be strong and well made. The lubrication is on the gravity system, the oil being used over again; the crankpits are oiltight, so that good filtration is necessary. Fifteen gallons is usual for the engines per day, and 20 gallons per day for pistons and auxiliaries. The latter are all steam-driven, a boiler being fitted in the engine room having two furnaces, the exhaust gases from the main Diesel engines continually passing through one, thereby utilizing the waste heat, while in the other is an oil burner. During the day we can dispense with the burner altogether, enough steam being generated by the waste gases.

The fuel consumption for all purposes per day is 9½ tons of gas oil, for the main motors 8¼ tons and for the boiler ¾ ton. This gives 0.3 pound per indicated horsepower per hour under average running conditions. The overall consumption, including auxiliaries, works out at a little less than .4 pound per indicated horsepower per hour.

When the vessel came out she was fitted with three-bladed propellers of 10-foot pitch, but there was considerable vibration in the ship. These propellers were later replaced by four-bladed wheels with a foot more pitch, the revolutions being then 105 per minute and with no vibration whatever.

In the writer's opinion, Diesel motors for marine work will be greatly simplified in the future. There is still a tendency to make them too complicated. There are too many parts to go wrong. There is no doubt, however, that as experience is gained many things will be altered. There is still a great field for research in this respect.

T. I. GRAINGER,
Chief Engineer, M. S. *Emanuel Nobel*.
Rouen, France.

The Need of an Enrolled Naval Reserve

The April issue of INTERNATIONAL MARINE ENGINEERING contains a timely editorial which discusses a method of obtaining a naval reserve and at the same time of assisting the merchant marine under the United States flag engaged in the foreign trade. This is a question of vital importance to the navy, but it is not at all generally appreciated by the American people.

The last Congress enacted laws which will give (at least they are expected to give) an adequate trained reserve for the active fleets as well as for those in reserve. This reserve will be composed entirely of men who have served in the navy and will, therefore, measure up to a high standard of efficiency and ability. The fact that members receive pay for their services should tend to make the majority of honorably discharged men, who are returning to civil life, desire to belong to the reserve. It must be understood that the formation of this reserve will be a rather slow proposition; nevertheless it should be successful in the end.

Every naval officer fully appreciates the urgent necessity for such a reserve. It is needed to bring existing complements up to their war strength, to fill up skeleton crews of vessels in reserve, and to furnish the men necessary to fill in in case of casualties. Contrary to usual opinion, even the ships in the active fleet which apparently have full complements would really need many more men to place them on an actual war basis. They could get along with the number they now have, but they would be much better off with from one hundred to two hundred additional men on each battleship. These additional men must come from the reserve.

But there is a reserve needed for another class of ships that cannot be classed as strictly naval vessels. By this I mean the men needed to man the immense number of vessels required to supply the wants of a modern fleet when operating at a distance from its established bases. The number of such vessels required to supply a first class modern battle fleet (including battleships, battle-cruisers, destroyers, mine layers, submarines, aviation ships, etc.) is simply astonishing to the untrained mind; in fact, it is astonishing even to the trained mind which has not care-

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fully investigated this matter. The number is so large that it is not well expressed by dozens or scores; it runs into the hundreds.

It is pertinent to inquire where we are intending to get the men necessary to man and operate this immense number of ships (even after we get the ships themselves). That they must be manned is not open to question; it is only a question of how efficiently they can be manned. It is difficult to believe that the ordinary merchant crew (which usually includes a large number of foreigners) would prove very efficient in this service in time of war. It would therefore appear extremely necessary to provide some means by which each vessel assigned to this auxiliary service could be immediately fitted out with an intelligent crew of American citizens. I do not mean to insinuate that it is not possible to have an intelligent crew which includes many foreigners, but I think that everyone will acknowledge that a foreigner can hardly be expected to take the same interest in the welfare of this nation that should be normally expected of an American citizen. It should therefore be the policy of the nation to use American citizens wherever it is possible to do so, when engaged in war.

The greatest difficulty in carrying out the above policy is the scarcity of Americans who follow the high seas as an occupation. The coastwise fleet, being all under the American flag, should furnish a good many men for such an auxiliary naval service, but surely it would not furnish more than one-third of those required. In addition to those in the coastwise shipping, there is a large body of men engaged on the Great Lakes. Many of these men have never seen the high seas, but, since a ship is a ship whether in fresh or in salt water, their lake experience, coupled with a desire to make good, ought to make them very adaptable for the auxiliary service. The writer believes that we shall be obliged to turn to the lake shipping for a large number of men in case of war. That these men will make good, after they have had a little experience, is not to be doubted.

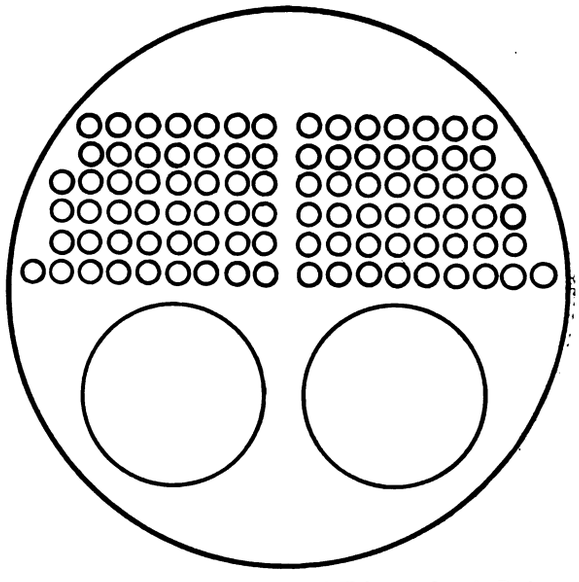
But even though we have fields from which some men can be obtained in case of need, this does not give us a system by which we know just how many men can be obtained, just what each man can do well, and where to send each man when the time comes. Some system of enrollment which will give all of this information (as well as much other) is badly needed. The needs of the fleet will not wait while we gather the information we should have carefully compiled in times of peace.

A NAVAL OFFICER.

Poor Circulation in Boilers

One of the common ailments found in boilers is poor circulation. This is due to several causes. Some boilers are improperly designed, and no change that will remedy this trouble can be made after they are built; but one of the causes of poor circulation that the writer has occasionally met with, and which is curable, is the placing of too many tubes in a boiler, due to the desire of the designer to get as much heating surface in the boiler as possible without exceeding a specified diameter. A boiler is sometimes found with the tubes arranged as in the accompanying sketch. It will be noticed that the top and bottom rows of tubes in this design extend close to the shell of the boiler, and that there is no break in the rows.

In the case illustrated, the steam formed on the furnace sheets cannot rise to the top freely, being checked by the flow of water downward, there not being space for one to pass the other. This defect could be remedied by removing one tube from each side of the horizontal rows and one vertical row in the center. This may be objected to on the grounds of insufficient heating surface and also of restriction of the passage of the burnt gases, but all marine engineers know that it is common for a boiler with 150 or 200 tubes to have 15 or 20 of them plugged at one time without any appreciable difference in the steaming qualities of the boiler. If this is so in a boiler that has good circulation, it follows that if by removing the same number of tubes in a boiler that has poor circulation the circulation is improved, the increased quantity of steam generated by the better circulation will more than compensate for the decreased heating surface and restricted draft. The boiler that has the more nearly perfect circulation, other things being equal, will generate the most steam.



Sketch Showing Arrangement of Tubes in Scotch Boiler

This admits of no argument, and anything that can be done to make the circulation better makes for better steaming qualities and economy of fuel.

The tubes in many cases are too close to the furnace crowns and the space does not permit perfect circulation. In some cases the tubes are too close together. Many boilers that have tubes 3 inches in diameter would do better work with tubes 2½ inches in diameter, spaced the same distance between centers, the better circulation more than compensating for the decreased heating surface, but these are defects that cannot be remedied once the boiler is built.

Poor circulation causes other defects besides decreased steaming qualities and waste of fuel. It is always found that boilers which have poor circulation are subject to corrosion and pitting internally, particularly under the back connections and bottoms of furnaces and flues. The water which lays stagnant in the bottom of a boiler soon becomes charged with all the elements of a galvanic battery and attacks the sheets with which it comes in contact. There are a number of good boiler circulators on the market, which circulate the water in the bottom of a boiler more or less effectively and are well worth the amount it costs to install them.

Another evil of poor circulation is the tendency of boilers so afflicted to foam. When there is insufficient space for the steam to rise to the surface of the water freely it accumulates near the heating surface, and when there is a sudden opening of the throttle, or lifting of the safety valve, the accumulated steam rises to the sur-

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face of the water rapidly and carries the water with it over into the steam pipe.

It is hardly necessary to mention the difficulty of keeping a boiler which is afflicted with poor circulation tight in the bottom seams. Every marine engineer is fully aware of this. Broken staybolts are another result of poor circulation. In raising steam on a Scotch boiler it frequently happens that the pressure rises to 100 pounds before the water in the bottom starts to circulate, and the sudden expansion of the bottom of the boiler when the temperature equalizes throws a severe strain on the staybolts that often causes them to break.

Practice and theory work splendidly together, much better than when used separately, and it would seem that all designers of boilers should study the practical operation of boilers as well as their theoretical efficiency. J. S.

Repairs to a Babcock and Wilcox Boiler

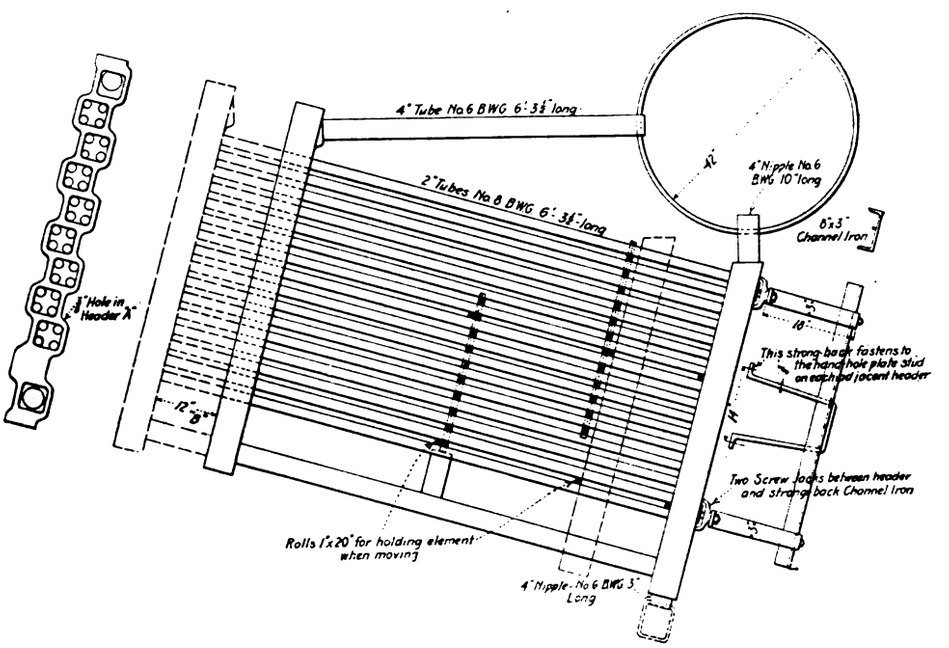
At about twelve hours forty-five minutes post meridian, January 26, 1915, while the U. S. S. *Nebraska* was steaming in formation at drill off the southern coast of Cuba, a violent noise caused by the escape of steam was heard in boiler No. 3. This gave no alternative save hauling fires with rapidity and trepidation. When this was completed, and safety permitted an examination to be made, it was found that water and steam were escaping between the fourth and fifth headers at the back of the boiler counting from the left.

When the vessel reached port as much of the asbestos as could be gotten at was dug from between the headers, showing the damage. The boiler was slowly filled until the defective header could be identified, which was found to be the fourth header. There were no spare parts of this kind available at the time, and on account of the strenuous duty necessitating the service of all power, it was decided to attempt repairs to the old header, which was then cut out, destroying thirty-six 2-inch seamless drawn tubes 8 feet 2 inches long, and two 4-inch seamless drawn tubes, one 6 feet 3½ inches long and the other 8 feet 2 inches long, a total cost of $51.50 (10/14/7).

The defect in the header was a hole about ⅜ inch in diameter which had blown in the curvature of the header, shown in the sketch and noted by the letter "A." The header was manufactured in 1900, and in making the curvature the metal had been drawn thin. As there is no means of cleaning the rust from between the headers, corrosion at these points is permitted to go on without abatement, thus rendering ruptures in old boilers to be expected, this being our third similar experience in two years.

After the header was cut out and sent to the repair ship the hole in the header was filled with metal by the oxy-acetylene process, so that metal projected into the header through the hole for a distance of 2 inches, the metal being built up on the outside only. The cost of rigging the header for a test being prohibitive, it was concluded to install the header without a test.

When the installation was completed, at a cost for material of $103 (21/9/2) and a labor cost of $44.52 (9/5/5), a test was put on the boiler and it was found to leak at a pressure of 150 pounds, the working pressure being 265 pounds. This looked like doing all of the work over again, which would have made the job cost, for material $154.50 (£31.7), labor $89.04 (£18.3), total $243.54 (£50). A realization of this fact made us adopt the following process, so as to save the tubes at least:


4" Tube No 6 BWG 6'-3⅝" long
2" Tubes No 8 BWG 6'-3⅝" long
4" Nipple No 6 BWG 10" long
6"x3" Channel Iron
⅜" Hole in Header A
This strong back fastens to the hand hole plate stud on each adjacent header
Two Screw Jacks between header and strong back Channel Iron
Rolls 1"x20" for holding element when moving
4" Nipple No 6 BWG 3" Long

Sketch Showing Arrangement and Method of Removing Element of Babcock & Wilcox Boiler for Purposes of Welding Hole in Rear Header

The upper 4-inch tube connecting the back header with the drum was heated with a blow torch where it is expanded into the header and the end crimped to allow the tube to be drawn from the header and left in place in the drum. The front and back doors were removed and the casing in wake of the header lifted clear. Two strongbacks were then made of ¼-inch by 3-inch steel, shaped so as to bridge the front header of the element having the defective back header. The nuts were removed from four hand hole plates in the adjacent headers, one from the top and one from the bottom of each header, the dogs being left in place in each case and the heels of the strongbacks being bolted to the boiler front by means of the studs in the handhole plates, as shown in the sketch. This gave a good, rigid brace for the work.

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A channel bar 8 inches by 3 inches was placed on the boiler side of the apex of the strong-backs, flanges pointing boilerward, and extending from one strong-back to the other, as shown in the sketch. Four bars of iron 1 inch in diameter and 20 inches long were placed in the boiler, as shown in the sketch, to form rollers to take the weight of the element as it was shoved back and thus relieve the pressure on the baffles.

The upper and lower 4-inch nipples of the front header having been cut out, screw jacks were placed between the channel bar and the front header and were gradually set up. The whole element was thus moved aft, without much difficulty, until the defective back header was exposed in the rear of the boiler sufficiently to permit of being worked on. This is shown in the sketch at "B."

With the header in this position the oxy-acetylene welding outfit was again brought into play and the metal built up over the defect to a greater thickness and spread out more over the outer surface. It was impossible to put metal on the inner surface, since it was an under surface.

This being completed the element was forced back into place, the upper 4-inch tube rolled in, the upper and lower front 4-inch nipples renewed, the bracing removed and the casing replaced and boiler tested. A test of 400 pounds was applied without any indications of a leak, and subsequent service under forced draft has shown no derangement.

The baffles in the boiler had been put in alinement and held there by metal strips ¼ inch thick, 4 inches wide, and extending from the top row of 2-inch tubes to the bottom row and clamped to the tubes. This alinement made it possible for the tubes to slide through the baffles without breaking or deranging them, and also made a testing of the alinement of the baffles after the completion of the repairs a very simple and easy matter.

A comparison of the costs of the two methods is given below:

Method	Time	Material	Labor	Total Cost
Cut out header.....	6 days	$103.00 (21/9/2)	$44.52 (9/5/5)	$147.52 (30/14/7)
Jack back header.....	4 days	$6.96 (1/9/0)	$32.68 (6/16/0)	$39.64 (8/5/0)

LIEUT. F. H. SADLER, U. S. N.

U. S. S. *Nebraska.*

UNITED STATES NAVY SPECIFICATIONS.—The new specifications of the United States Navy indicate a changed opinion as to the extent to which sulphur is detrimental in steel castings. Former specifications allowed a maximum of 0.05 percent sulphur in all carbon castings of grades A, B and C and 0.04 percent in nickel-steel castings designated as "special grade." In the new specifications grades A and B are subdivided into two classes—A and D, the high carbon, and B and E, the medium carbon relatively. A and B maintain the old limit of 0.05 percent sulphur and D and E permit castings to go as high as 0.07 percent sulphur. The two subclasses include castings of less importance than the others. For castings in grade C the limit is changed from 0.05 percent sulphur to 0.07 percent. The nickel-steel or special grade castings now have 0.05 percent instead of 0.04 percent sulphur as the limit. The requirements for tensile strength are reduced from a minimum of 90,000 pounds per square inch in nickel-steel to 85,000 pounds. The elastic-limit stipulation is 45 percent of the tensile strength in carbon castings, instead of a definite limit in pounds. The elongation requirements are advanced from 20 to 22 percent in the special, or nickel-steel, grade, and the bending bar required is 120 degrees instead of 90 degrees.—*American Machinist.*

Grab Dredgers

Fig. 1 shows two of the latest type of grab-dredgers made by Messrs. Priestman Bros., Ltd., Hull, fitted on a wooden pontoon at work in Sydney harbor. They take steam from a main boiler on the center of the pontoon. These grab-dredgers are capable of a working load of 8 tons at 40 feet radius and are equipped with two different designs of grabs, the grab-bucket and whole-tine types, the latter for dealing with hard material.

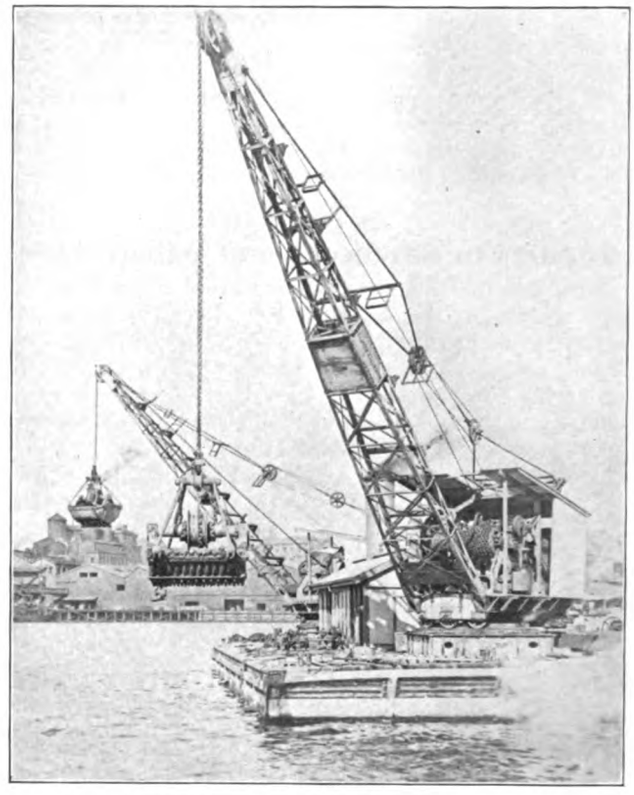

Fig. 1.—Grab-Dredger Pontoon

Priestman grab-dredgers have recently been fitted on self-propelled steam hopper barges, built by Mr. Joseph Constant, of London, for the Great Central Railway Company for their new port of Immingham. The dimensions of the vessels (Fig. 2) are: length, 132 feet 6 inches; beam, 28 feet 6 inches, with a hopper capacity of 600 tons.

Fig. 2.—Grab-Dredger Hopper Barge

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Marine Articles in the Engineering Press

Official Trials of New United States Destroyers—New Shipyard Tools and Methods—Electric Propulsion

Description of Trials of the Torpedo Boat Destroyer Downes.—By Lieutenant R. M. Griffin, U. S. N. The *Downes* is one of eight destroyers authorized by Congress on March 4, 1911. She is a twin screw vessel fitted with a combination of Curtis turbines and reciprocating engines and was built under contract by the New York Shipbuilding Company, Camden, N. J., at a price of $777,500 (£160,000). The hull is 300 feet long between perpendiculars, 30 feet 9 inches molded beam with a draft of 9 feet 11 inches on a displacement of 1,126 tons. The block coefficient is .418. The boilers are of the Thornycroft type arranged in pairs in two separate firerooms, each boiler being equipped with seven Schütte & Koerting fuel oil burners. A description is given of the main and auxiliary machinery and of the official trials. 1 illustration. 6,300 words.—*Journal of the American Society of Naval Engineers,* May.

An Air Fleet: Our Pressing Naval Want.—By Commander Thomas Drayton Parker, U. S. N. Before discussing the air fleet and its uses, a description is given of the various types of aircraft to be considered, including kites, balloons, aeroplanes and dirigibles. The paramount duty of both dirigibles and aeroplanes, in which their usefulness is proved by events during the present war, is reconnaisance. In addition to this, they are useful for screening and spotting. For offensive uses the weapons of the dirigible are rapid fire or machine guns, automatic rifles and bombs. For protection against aircraft the aerial gun is the main resource. After outlining the present position of aeronautics abroad, the point is emphasized that the present strength of our air fleet is: dirigibles, none; aeroplanes, including seaplanes, 23, which, compared with the strength of other nations, means that we are among the smallest of the minor air powers. The author makes a strong plea for the immediate construction of both the dirigibles and aeroplanes. 25,400 words.—*United States Naval Institute Proceedings,* May-June.

New Shipyard Tools and Methods.—By H. P. Phelps. This article describes the new tools and methods in use at the yards of the Newport News Shipbuilding & Dry Dock Company, where the equipment has been developed gradually, as the capacity of the yard has expanded. Of the three methods of driving machine tools in common practice, the centralized or single unit drive, the group drive and the individual motor drive, it has been found that the individual motor drive is by far the most satisfactory from an operating standpoint, but because of the fact that most machines take double the power to start them than is required to operate them after starting, with the consequent enormous first cost of equipping a shop complete with individual motor drives, it has been found advisable to install simple group drives in many instances. It is the intention of the management at present to scrap the very inefficient hydraulic pumps now installed for those of motor drive type, as it is assumed that a power saving of 100 percent will be accomplished by this change. As a result of investigations, the Newport News yard has installed a complete plant for the manufacture of gases for operating oxy-hydrogen and oxy-acetylene welding and cutting apparatus which has been found very efficient and economical for shipyard work. Two semi-automatic machines for milling turbine blading have also recently been installed with considerable savings for this class of work. In November, 1913, a tool-making department was organized, comprising a tool steel storage room and a heat treatment department, storage department, die-making department, machine department, grinding department and a tool storage room. The functions of this department include the purchase and selection of all the tool steel used at the yard and the manufacture complete, including the forging, machining, heat treatment and grinding of all the tools manufactured for use in the yard. Very favorable results have been obtained from this department. 5,000 words.—*The Journal of the American Society of Marine Draftsmen,* January.

The 250-Ton Floating Cranes for the Panama Canal.—Drawings are given of the original designs of the 250-ton floating cranes *Ajax* and *Hercules,* built by the Deutsche Maschinen Fabrik, A. G., of Duisburg. Steps are now being taken to repair the jib of the *Ajax,* which collapsed early in December last. The *Hercules,* however, was accepted by the canal authorities at the end of March and is now employed on work on the canal. The cranes were required to lift 250 tons at a reach of 21 feet over the ends and 22.3 feet over the side of the pontoon, and 100 tons at a reach of 80.1 feet over the end and 81.6 feet over the side of the pontoon. There were to be no moving counterweights. The pontoons are not self-propelling, but are furnished with warping capstans. They are very carefully designed with watertight compartments, any two of which can be flooded without impairing the stability of the crane. The pontoons are 150 feet 2⅝ inches long by 88 feet 9¼ inches wide, and have a depth of 15 feet 9 inches at the sides and 16 feet 8 inches at the center. Complete, each crane comprises about 2,869.3 tons of material made up as follows: Pontoon, 1,634.4 tons; electric plant, coal, water, etc., 173.7 tons; steel superstructure, 543 tons; machinery, 368 tons; counterweight motors, control gear, etc., 150.2 tons. 5 illustrations. 600 words.—*Engineering,* June 11.

Electric Propulsion for Battleships.—By Assistant Naval Constructor H. G. Knox, U. S. N. The reason why electric propulsion is being adopted, the author points out, is because other forms of reducing gear comprise a single ratio gear with a non-reversible turbine, which gives economical results for one speed only, whereas with electric propulsion economic, reliable, quick reversing drive is obtained at both high speeds and at cruising speeds. He maintains that only when mechanical engineers succeed in producing a reliable, quick reversing, two-speed gear capable of handling 7,000 horsepower at 160 revolutions per minute will the day of electric propulsion be over. In describing the details of electric propelling machinery, the author takes up first the alternator, then alternating current motors, induction motors, the phase-wound induction motor, and the double squirrel cage induction motor. Summing up the advantages of the various types of motors, the author points out that the double squirrel cage induction motor is by far the best solution for ship propulsion. 26 illustrations. 13,400 words.—*United States Naval Institute Proceedings,* May-June.

Description and Trials of U. S. Torpedo Boat De-

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stroyer Nicholson.—By Lieutenant W. F. Cochrane, U. S N. The *Nicholson* is one of six destroyers authorized by Congress August 22, 1912, and is one of three built by William Cramp & Sons Ship & Engine Building Company, Philadelphia, Pa., at a contract price of $842,000 (£172,500) for each vessel. The hull is 300 feet long between perpendiculars, 30 feet 4 inches molded beam, with a mean draft of 9 feet 5 inches on a displacement of 1,050 tons. The block coefficient is .426. Propulsion is by two Cramp-Zoelly turbines, arranged on two shafts, with a compound reciprocating cruising engine on the forward end of each shaft. Between the cruising engine and the turbine there is a hydraulically-operated friction clutch designed by Mr. J. F. Metten, chief engineer of the Cramp shipyard. A table is included, giving the dimensions of shafting, bearings, etc., as well as details and dimensions of the auxiliaries. Data from the standardization and other trials are given. 1 illustration; two tables. 3,600 words.—*Journal of the American Society of Naval Engineers,* May.

Steam Turbine Blade Fastenings.—By James A. Capstaff. Repeated tests of steam turbines have proved that the efficiency of a turbine varies with the blade speed and the number of rows of blades, and also that the number of rows of blades varies inversely as the square of the blade speed for a given efficiency. Increasing the number of revolutions per minute offers increased efficiency with smaller turbines, and the tendency is to develop along these lines. It is a question as to how far the peripheral speed of the blades can be increased and the size of the turbine reduced. The answer must be determined by the strength of the materials. Theoretically, the limit would be reached when the mean blade speed equals between .75 and .9 that of the steam in the case of a Parsons reaction turbine, and .5 in the case of a pure impulse turbine. Quite a common pressure drop through a turbine is from 265 pounds per square inch down to 28 inches vacuum. This drop in pressure represents a steam velocity of 4,200 feet per second. While the possibility of ever increasing the theoretical blade limit is remote, nevertheless the tendency is to go on increasing the blade speed. It should be noted that Parsons' turbines seldom exceed 550 feet per second at the mean diameter of the last expansion, Curtis as high as 700 feet per second, and De Laval 1,375 feet per second. All, however, are a long way behind the theoretical most efficient speed. With the increase of revolutions, if the diameter is kept down, the blade heights must run up. This cannot be done, however, without taxing the strength of the blade and its fastenings. A detailed description is given of the various methods of blade fastenings, including the Parsons, Westinghouse, Fore River, De Laval and the Lovekin methods. In Mr. Lovekin's method the rotor, or disk, is grooved with plain dovetailed grooves into which is inserted a tongued locking piece about 12 inches long. Alternately the blades and the distance pieces, whose roots are milled to a dovetail on one side and a recess on the other, are threaded on to this locking piece until the length is made up. Another piece of locking strip is inserted and more blades and distance pieces threaded on, and the operation repeated until the entire circumference of the groove is filled up, with the exception of a piece of locking strip equal in length to two blades and two distance pieces. After assembling one complete row, the locking ring is calked well down to make sure that the blading completely fills the groove. Mr. Lovekin's side locking piece is so designed that, in the process of calking, the roots of the blades and the distance pieces are first brought in contact with the bottom of the groove, and then the blades and distance pieces are forced bodily against the side of the rotor grooves. The bottom of the locking piece is under-cut so that in calking a spreading action takes place at the bottom and tightens the lower portion of the blading as well as the upper. Special mention is made of the admirable features of the Lovekin method, which are rigidity; great direct pulling strength; the fact that heavy calking is not required to give it its direct pulling strength; that full advantage has been taken of the best known method of assuring rigidity, namely, side calking; the blading operation is quick and so simple that the services of experienced bladers are not essential; it is foolproof; no special recesses are required around the circumference of the rotor grooves for the insertion of the blades (an item of importance in reblading); extended distance pieces, so valuable in strengthening the blades against bending, and providing a good steam line across the stage, can be used; perfect alinement of the blades in a row is assured, and there is no abrupt change of section or blade at the surface of the rotor. 24 illustrations. 5,500 words.—*Journal of the American Society of Naval Engineers,* May.

Heat Transmission and Tube Length in Marine Feed Water Heaters.—By Professor Leo Loeb, M. E. This article describes a method to develop the theory of heat transmission as applied to closed heaters operating on exhaust steam, and also the application of this theory with reliable data from tests of marine feed heaters to the preparation of design curves incorporating all the operating variables for a given type of heater. There is given first the general theory of heat transfer from steam to water, thermal resistances and a mathematical discussion of temperature differences or temperature gradients. The data used to determine the heat transfer in marine heaters were taken from tests on a Bureau of Steam Engineering heater and a Schutte & Koerting spirally corrugated film heater. The data thus obtained are incorporated in a number of design curves which permit a graphical solution of problems of feed heater proportions for a given type of heater. From the tests considered in the paper, the following conclusions were drawn: That closed feed water heaters developed for marine purposes have temperature gradients resulting from the general relation that heat transfer is proportional to some power of the temperature difference; that the numerical value of the exponent for the heaters tested is less than unity; a vertical tube permits higher rates of heat transfer than a horizontal tube due to the more effective disposal of condensate; film tube heaters give much higher rates of heat transfer than plain tubes, or tubes with retarders; the clearance between the tubes making up a film unit can be great enough to prevent excessive friction loss in the form of pressure drop without in the slightest decreasing the efficiency of the film agitation which renders this type more effective for heat transfer than a plain tube; air carried into the steam space of a feed water heater will seriously interfere with heat transmission in any type of heater, if allowed to accumulate for any considerable period of time; water film agitation is more important than steam side film agitation, and air free condensation are essentials to the maintenance of high rates of heat transfer. 20 illustrations, 13 tables, 3 appendices. 15,000 words.—*Journal of the American Society of Naval Engineers,* May.

The Ships of the United States Navy, 1776 to 1915.—By Robert W. Neeser. This is an installment of a series of articles giving an historical record of the ships now in service in the United States Navy and of their predecessors of the same name. This article deals with the *Arizona* and *Pennsylvania.* 3 illustrations. 5,800 words. *United States Naval Institute Proceedings,* May-June.

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New Books for the Marine Engineer's Library

A Noteworthy Treatise on Structural Design of Warships—Elementary Works on Mechanics and Valve Gears—Scientific Management

BEESON'S MARINE DIRECTORY OF THE NORTHWESTERN LAKES. Size, 6¾ by 9¾ inches. Pages, 288. Numerous illustrations. Chicago, 1915 Harvey C. Beeson. Price, $5.

This directory is now in its twenty-ninth year of publication and every effort has been made to make the data given regarding American and Canadian sailing, steam and gas-engined vessels on the Northwestern Lakes accurate and authentic in every detail. The lists of vessels give the rig, principal dimensions, date of building and the name and address of the owners in convenient tabulated form. A record of engines and boilers is included, together with lists of special types of vessels, such as lumber steamers, as well as the officials of various marine organizations on the Lakes. A very important feature of this year's volume is a port directory of Canadian harbors, published by authority of the Minister of Marine and Fisheries of Canada from a compilation of the Port Directory of Canada. The physical characteristics of each harbor are briefly described, indicating the docking and anchorage facilities as well as lights, port charges, etc. The book is replete with excellent illustrations of noteworthy ships and important marine events of the year, supplemented by brief articles regarding marine affairs on the Lakes and improved marine appliances.

STRUCTURAL DESIGN OF WARSHIPS. By Professor William Hovgaard. Size, 6¼ by 9¼ inches. Pages, 384. Illustrations, 186. New York, 1915: Spon & Chamberlain. Price, $5.50 net. London, 1915: E. & F. N. Spon, Ltd. Price, 21s. net.

With public attention focused by the present European war upon naval strength and the relative value of different types of warships, this volume by Professor Hovgaard, late commander of the Royal Danish Navy, and now professor of naval design and construction, Massachusetts Institute of Technology, is particularly timely. The book is based on a series of lectures prepared for a course in naval construction, which was established by the Massachusetts Institute of Technology in 1901 for officers of the United States Navy detailed to take this course in preparation for duty as naval constructors. Although the work was prepared chiefly as a text-book for students of naval construction, it goes considerably beyond the limits of ordinary text-books, and in the theoretical treatment of the subject much is presented that is new.

The early chapters deal with longitudinal strength, transverse strength and the strength of individual girders. Following this, there are chapters on the strength of a rectangular plate under fluid pressure, and of columns and plating under compression. Seldom has the application of scientific principles to structural design been more carefully worked out than in the treatise which Professor Hovgaard gives of the design of the structural members of warships. The results are of immediate practical value to anyone who has to do with design problems of this nature.

In the chapter on riveting and calculations for riveted joints, the author most carefully investigates the method of failure of all forms of riveted joints commonly used in hull construction, and extends the investigation to the riveting of bulkhead liners and doubling plates—a subject on which little discussion is available.

Shell plating, framing, decks and bulkheads are in turn exhaustively treated, and, in the theoretical treatment in these chapters, much is given that is novel, while in the chapters on practical application the author advances a number of suggestions for new structural features.

Professor Hovgaard's methods of investigating the problems of strength in structural members are in a measure known to readers of this magazine from the papers which he has presented before the Society of Naval Architecture and Marine Engineers and the Institution of Naval Architects. The present volume brings into readily accessible form the results of exhaustive investigations and research from sources of information which are widely scattered, and in most of the subjects discussed the different practices employed by various nations in warship design are compared.

WORK, WAGES AND PROFITS. Second edition. By H. L. Gantt. Size, 5 by 7¼ inches. Pages, 312. Illustrations, 27. New York, 1913: The Engineering Magazine Company. Price, $2.

In bringing out a second edition of this well-known volume, the subject matter has been thoroughly revised and enlarged by the inclusion of additional instances of the application of scientific methods to labor problems, and also by giving more detailed developments of some features of the work and the summation of the argument into a comprehensive and complete outline of a plan of systematic management, based on the policies and methods defined by the author.

VALVE GEARS. By Prof. Charles H. Fessenden. Size, 6 by 9 inches. Pages, 170. Illustrations, 171. New York, 1915: McGraw-Hill Book Company, Inc. Price, $2 net.

Only steam engine valve gears are discussed in this book, and the subject matter is presented in the form of an elementary treatise for use principally as a text-book for students in an engineering college. The Zeuner and Bilgram diagrams are both used throughout the book and are given almost equal consideration. Some of the most useful constructions belonging to the Reuleaux diagram have been incorporated in the Zeuner solutions in order to avoid introducing a third diagram.

ELEMENTARY MECHANICS FOR THE PRACTICAL ENGINEER. By John Paul Kottcamp. Size, 5½ by 8¼ inches Pages, 181. Illustrations, 85. New York, 1915: McGraw-Hill Book Company, Inc. Price, $1.50 net.

The subject matter of this book comprises a series of thirty lessons published in *Power* as part of an engineer's study course. The aim of the entire course is to present only those principles of mechanics which could be directly applied to the various phases of power plant operation. The problems given in the book were selected with this point in mind. The book is a clear exposition of a branch of science which should be understood by every practical engineer.

THE FORE RIVER LOG.—A 16-page magazine known as the *Fore River Log*, published in the interests of the employees of the Fore River Shipbuilding Corporation, Quincy, Mass., made its first appearance in May of this year. The various activities of the community of 5,000 men who comprise the shipyard force are described and illustrated in a most interesting manner.

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Shipbuilding and General Marine News

Contracts for New Ships—Marine Terminal Improvements—Recent Launchings—Improved Appliances—Personal Items

New York merchants and capitalists, according to reports, have organized a syndicate with a capitalization of $100,000,000 (£20,500,000) to build a large number of vessels for use in the foreign trade. In addition to this syndicate, two other projects are being considered, each involving the construction of about ten large freight carriers. One of these is interested in the West Indian trade. Because of these projects and other inquiries out for over fifty steam vessels, the prospects for establishing additional shipyards in the United States are very promising.

That an important project is on in connection with the William Cramp & Sons Ship & Engine Building Company, Philadelphia, is indicated by the sale of a large amount of its stock and a sudden rise in its price from 27 to over 60 during the past month. Among other new shipyard projects is the reopening of the old Crescent Shipyard at Elizabethport, N. J., now known as Samuel Moore & Sons Company. It is understood that this plant will be considerably enlarged and will specialize in the construction of submarines. The old Roach shipyard property at Chester, Pa., changed hands recently and an English syndicate will re-establish this yard for the construction of steel hulls. The New Haven Shipyard Company, recently organized at Bridgeport, Conn., has taken over the shipyard of J. E. Mar & Son Company, West Haven, Conn. There is also a report that the Shooters Island Shipyard will be reopened.

The fifty or more inquiries now out for new vessels are for tonnages ranging from 4,000 to 18,000, and they include inquiries from Great Britain, Norway, France, Germany, Spain, Russia, Denmark, Portugal and China. At the present time American shipyards are turning out about 175 vessels a month and two or three of the largest yards on the Atlantic coast are unable to take an order for delivery inside of 24 to 30 months, as they each have enough work on hand to keep over 6,000 men employed. In a number of yards there is a shortage of labor and high wages and continuous employment are offered to artisans of all classes.

Recent Contracts Placed with Atlantic and Pacific Coast Yards

The Fore River Shipbuilding Corporation, Quincy, Mass., has received a contract from the Luckenbach Steamship Company, New York, to build a freight steamship 437 feet long.

William Cramp & Sons Ship & Engine Building Company, Philadelphia, Pa., has has received a contract from the Mexican Navigation Company, Vera Cruz, Mex., to build a passenger and freight steamship at a cost of about $800,000 (£164,000). It is also reported that this company has received an order from the Russian government for several small boats.

The Staten Island Shipbuilding Company, West New Brighton, N. Y., has received an order through Eads Johnson, New York, from the Huasteca Petroleum Company, New York, for a 10,000 barrel oil barge.

The Maryland Steel Company, Sparrows Point, Md., has secured an order from the Munson Steamship Line, New York, for two freight steamships, each of about 7,000 tons. These are understood to be in addition to the contracts for two freighters for this company placed some weeks ago.

The New York Shipbuilding Company, Camden, N. J., has recently received orders to build two tank steamers to cost about $1,000,000 (£205,000).

The John W. Sullivan Company, New York, has received a contract to build a steam lighter for the Delaware, Lackawanna & Western Railroad Company, New York. The hull of the vessel will be constructed by the New Jersey Dry Dock Company, Elizabethport, N. J.

A. C. Brown & Sons, Tottenville, N. Y., has a contract to build a wooden tug for the Carrol Towing Company, New York.

Hampton C. Ellis' Son, Tottenville, N. Y., is building a 50-foot combination tug and passenger boat for the Hewitt Bearing Metal Company, Newark, N. J.

The Greenport Basin & Construction Company, Greenport, N. Y., has received a contract to build twelve 60-foot, 25-knot power boats.

The Charles R. McCormick Company, San Francisco, Cal., has placed a contract on the Atlantic coast for a lumber steamer 415 feet long, and this company has also ordered two auxiliary power schooners to be built on the Pacific coast.

The Union Iron Works, San Francisco, Cal., has received a contract from the Union Oil Company of San Francisco to build an oil tank steamer at a cost of about $1,000,000 (£205,000).

New Vessels Ordered from Shipbuilders on the Great Lakes

The Great Lakes Engineering Works, Detroit, Mich., has received an order from the Clyde Steamship Company, New York, for three single screw freight steamers designed by Theodore E. Ferris, naval architect, New York, which will cost about $175,000 (£36,000) each. This yard also has contracts from A. L. Crosthwaite, New York, for a steamer for the coast trade and from a New York firm for a steamer about 250 feet long.

The Collingwood Shipbuilding Company, Collinwood, Ontario, has a contract to build a steel tank steamer for the Imperial Oil Company, Toronto, Ontario.

Bath Shipyards Busily Engaged with New Work

The shipyards of Bath, Me., have more work on hand than they have had for many years past. The Kelly-Spear Company is building three large wooden barges for the coal-carrying trade. The Gardner C. Deering Company is building a five-masted schooner, and Percy & Small will shortly begin construction on a four-masted schooner. The Bath Iron Works will soon begin work on the two torpedo boat destroyers and a large steam yacht, contracts for which were received some months ago.

Frank S. Bowker & Son, Phippsburg, Me., is building a three-masted wooden schooner.

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Shipbuilding Contracts Soon to be Placed

Several orders are about to be placed by various departments of the Federal Government, outside of navy contracts, for which bids will be asked in July or August.

George Simpson, naval architect, New York, is preparing plans for a large steel freight steamship, contract for which will shortly be let by the Union Sulphur Company, New York.

The New York & Cuba Mail Steamship Company (Ward Line), New York, will shortly place a contract for two large steel passenger and freight steamships, designed by Theodore E. Ferris, naval architect, New York.

Eads Johnson, naval architect, New York, is preparing designs for several vessels and will shortly ask for bids.

M. Moch, superintendent of the Richmond-San Rafael Ferry Company, San Rafael, Cal., will shortly place a contract for a ferryboat to cost about $125,000 (£25,600).

Two large banana companies in New Orleans, La., have combined and will shortly be in the market for fruit steamers. Mr. John Beninato, of New Orleans, is president of the company.

New Steamboat Companies Organized to Operate on the Mississippi River

The Inland Navigation Company has been organized with a capital stock of $9,000,000 (£1,840,000) to build and operate steam barges and other vessels on the Mississippi river.

A company has also been organized with a capitalization of $1,000,000 (£205,000) to be known as the Chicago, St. Louis & Gulf Transportation Company, to run a fleet of river boats between Chicago and New Orleans.

The Ohio River Improvement Association, Cincinnati, Ohio, has made plans to build and operate a line of freight steamers between that city and New Orleans. Both steamboats and barges will be built for this purpose, and it is understood that the vessels will be larger than anything ever used on the Ohio river.

Marine Terminal Projects

Dock Commissioner R. A. C. Smith, of New York City, recently opened bids for the construction of a new pier at the foot of Thirtieth street, New York, and also for a new pier at Twenty-ninth street, Brooklyn, N. Y., to be occupied by the United States Steel Products Company.

The Department of Wharves, Docks and Ferries, Philadelphia, Pa., is having plans prepared for a double-deck reinforced concrete pier 250 feet by 900 feet, to be erected at the foot of McKean street.

The Stone & Webster Engineering Corporation, Boston, Mass., has a contract for the construction of a pier for the Galveston Wharves Company, Galveston, Tex.

D. L. Taylor Company, Inc., Medina, N. Y., has received a contract to build a public wharf at Dunkirk, N. Y., to cost about $70,000 (£14,300).

The municipal authorities of the city of Baltimore, Md., realizing the need of larger dock facilities, are considering a proposal to construct and equip with mechanical freight handling appliances eight municipal piers.

The city of Beaumont, Tex., has voted in favor of a $100,000 (£20,500) bond issue to complete proposed wharf, dock and terminal improvements.

The city of Evanston, Ill., will soon vote on a $50,000 (£10,250) bond issue for the construction of piers.

Herbert D. Mendenhall, consulting engineer, Lakeland, Fla., has been retained to design and install the wharves and terminals of the Commodores Point Terminal Company. The improvements include the construction of one mile of wharves on the St. Johns river.

It is reported that the St. Louis & San Francisco Railway Company, St. Louis, Mo., will spend $30,000 (£6,180) in the construction of a wharf along the Warrior river at Cordova, Ala.

The Baltimore & Ohio Railroad Company, Baltimore, Md., is having plans prepared for a coal pier to be built at Curtis Bay. This pier will be about 700 feet long and will cost about $1,000,000 (£205,000).

The City Commission of Orange, Tex., will soon call an election to vote on a bond issue of $150,000 (£30,800) for building wharves and docks.

Baltimore Shipbuilding Plant Reorganized

The Baltimore Dry Docks & Shipbuilding Company, Baltimore, Md., recently organized, has taken over the two shipbuilding plants and other properties of the Skinner Shipbuilding & Dry Dock Company. The officers of the new company are: President, Thomas H. Bowley, chairman of the board, Baltimore Trust Company; vice-president and general manager, Holden A. Evans, formerly naval constructor U. S. N.; assistant manager, J. M. Willis; treasurer, William C. Seddon; secretary, William W. Coe. Mr. Evans, who has had charge of the Skinner Shipbuilding & Dry Dock Company for the past year, will be the active manager of the new company. The plant is equipped with two dry docks, 600 and 437 feet long, respectively, and in addition there are shops and equipment for all classes of repair work and for the construction of tugs, torpedo boats, submarines and other vessels not exceeding 340 feet in length. The plant will be greatly improved and it will be the aim of the management to make it efficient in every department.

Electrical Equipment at the Smith Shipbuilding Plant, Norfolk, Va.

The electrification of the F. O. Smith Shipbuilding & Dry Dock Company's dry dock at Norfolk, Va., is a notable example of the saving that can be effected by the use of electricity in shipyards. Previous to July, 1912, the dry dock was operated by old-fashioned steam-driven bucket pumps. With this equipment practically half a day was required to make a haul, and occasionally trouble was experienced with the operating machinery. In seeking to improve the operation and shorten the time required to lift a vessel, the owners decided to replace the steam equipment with electrically-driven pumps. Accordingly, twelve 20-horsepower, 1,135 revolutions per minute Westinghouse electric vertical motors coupled to 10-inch Morris centrifugal pumps were installed.

The installation met with such immediate success that in February, 1915, another section was added and six additional pumping units, duplicates of those previously installed, were purchased and placed in position. The dock will accommodate vessels not over 260 feet long on the keel blocks or 3,000 tons deadweight. It is now possible with this new equipment to lift a vessel high and dry in seventeen minutes at an energy cost of about $4.50 (18 9), whereas with the old equipment it required half a day and cost from $12 (2/10 0) to $15 (3/2 6).

In addition to the electrically-driven pumps on the dock, the shipyard is fitted up with a very complete line of shipbuilding machinery, including air tools, modern machine,

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boiler and blacksmith shops, a marine railway with a concrete foundation (said to be the only one of the kind in the world), a saw mill and a Westinghouse electric welding outfit equipped also for cutting.

River Steamer Converted to Freight Barge

The freight and passenger steamer *Capital City*, built forty years ago at Wilmington, Del., is about to end her career in the freight and passenger service from Washington, D. C., to the lower Potomac River points. All of her upper works and machinery have been removed and the hull will be converted into a freight-carrying barge for service on the Chesapeake Bay and its tributaries. During her long career on the Potomac River this vessel proved herself one of the most reliable steamers in the river service.

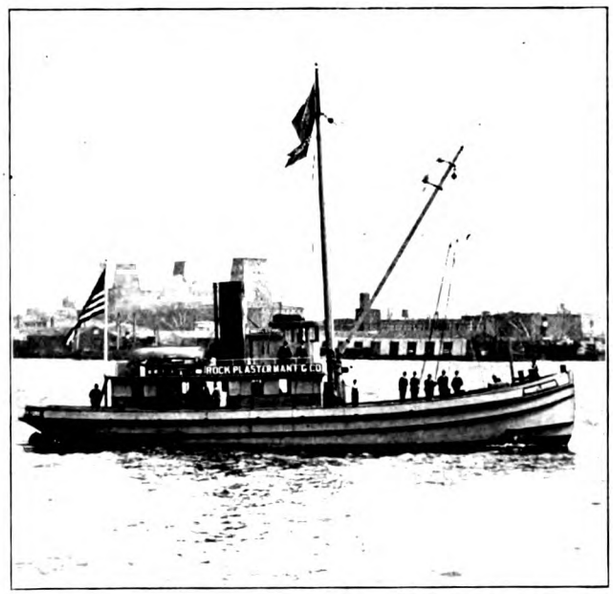
Battleship Arizona Launched

The United States battleship *Arizona*, sister ship of the *Pennsylvania*, was launched at the navy yard, New York, on June 19. The vessel is of 31,400 tons normal displacement, with a length of 600 feet on the waterline, a beam of 97 feet and a mean draft of 28 feet 10 inches. The main armament will consist of twelve 14-inch guns mounted in four triple turrets on the centerline. Propulsion is by Parsons turbines.

New Steam Lighter

Verdon & Co., of Staten Island, N. Y., has recently delivered to the Rock Plaster Manufacturing Company, of New York, a new steam lighter, called the *Robert L. Stevens*, which was built from designs by Cox & Stevens, naval architects, New York. The lighter is designed to carry practically all of her cargo on deck, and accordingly the machinery, deck house and derrick have been kept as far aft as possible and the lines have been designed so she will trim properly when light or loaded.

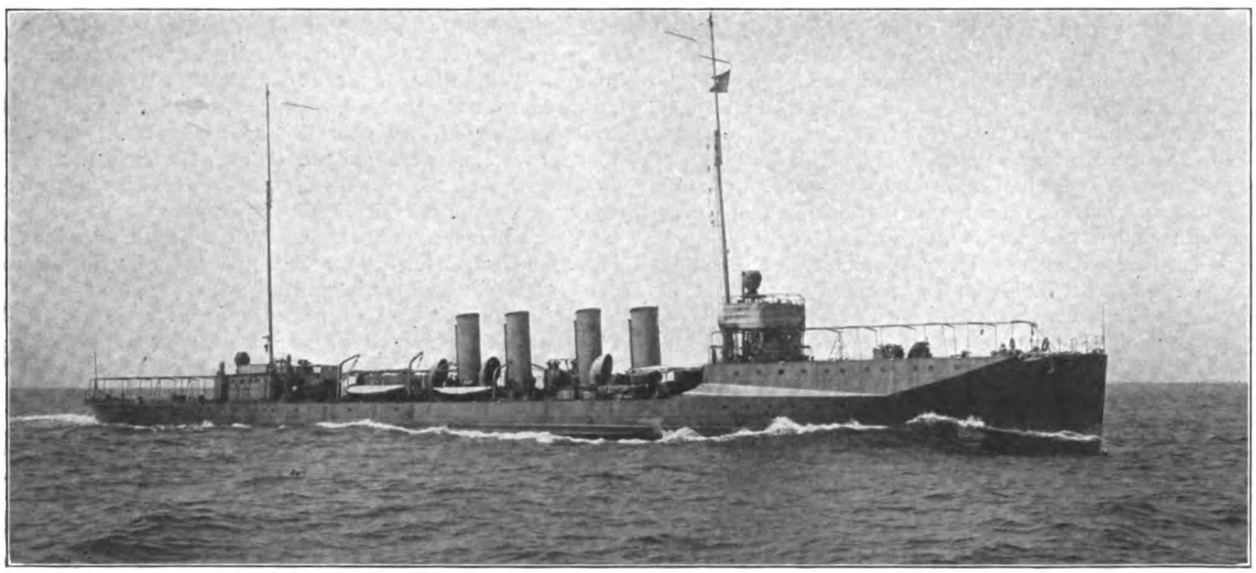
The hull is 97 feet long overall, 28 feet 6 inches beam molded, 10 feet depth of hold and 9 feet 6 inches draft. She has a cargo carrying capacity of 160 tons. Propulsion is by a single cylinder engine, 18 inches diameter by 24 inches stroke, driving a cast iron propeller 7 feet 8 inches diameter by 10 feet pitch. Steam is supplied by a leg type boiler 9 feet diameter by 13 feet long, built by Heipenshausen Bros.



Steam Lighter *Robert L. Stevens*

LAUNCH OF THE WAINWRIGHT.—The United States torpedo boat destroyer *Wainwright* was successfully launched at the works of the New York Shipbuilding Company, Camden, N. J., June 19. The new destroyer is a sister ship to the *Jacob Jones*, recently launched at the same yard, and has a length overall of 315 feet and a beam of 30 feet 6½ inches. Her armament includes four 4-inch 50-caliber rapid fire guns and four 21-inch torpedo tubes.

SHIPBUILDING RETURNS.—The Bureau of Navigation, Department of Commerce, reports 173 sailing, steam and unrigged vessels of 19,494 gross tons, built in the United States and officially numbered during the month of May.



(Photograph by the New York Shipbuilding Company)

U. S. S. *Ericsson* Making a Speed of 30.41 Knots on Her Trial Trip

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ENGINEERING SPECIALTIES

Submarine Photography

Submarine photography, or the taking of pictures, both stationary and moving, under water, is made possible by an invention of Charles Williamson and his two sons, of Norfolk, Va., which consists of a collapsible accordion-like

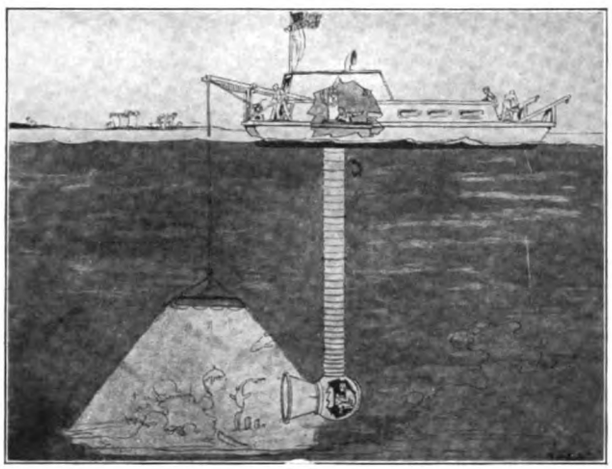

Fig. 1.—Williamson Submarine Photographic Apparatus in Actual Operation

submarine tube of waterproof canvas and rubber, 3 feet in diameter, braced at regular intervals by iron rings. This construction permits the passage of a person down the tube, and its flexibility permits it to be dragged along by a vessel. The top of the tube remains open at the deck and the lower end extends down into the water and expands into a chamber about 5 feet in diameter, one side of which is provided with an observation glass window through which the pictures are taken. The space in the chamber is sufficient to admit two men, one to operate the camera and one to control the movement of the tube, which is effected by chains operated from the deck of the boat. Fresh air is provided by a simple device, enabling the operators to work in comfort.

Artificial illumination under the water for taking the pictures is secured by a battery of nine Cooper Hewitt quartz lamps, each having 2,400 candlepower. This lamp consists of a short tube of pure fused quartz or silica containing vapor of mercury, which is made luminous by the passage through it of an electric current. The essential parts of the lamp are the quartz burner and the auxiliary. The former is the light-giving tube, its support and enameled reflector, while the latter consists of the necessary tilting mechanism and coils for starting and maintaining the mercury arc. The auxiliary is kept on board the boat, and the burner with its reflector holder is mounted in a casing that is placed in a frame and lowered into the water.

The construction of the lamp and its method of installation are shown in Fig. 1. Photographs and moving pictures have been made through the water by the method described for a distance of 100 feet. The photograph (Fig. 2) of the diver exploring an old wreck of a ship, 50 feet away from the camera, indicates one of the numerous practical uses to which this most important development may be put.

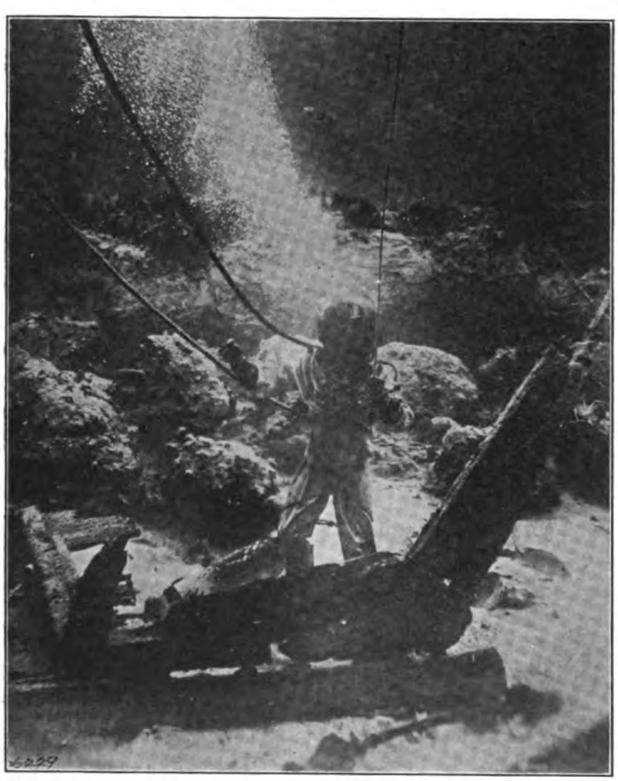

Fig. 2.—Photograph of Diver Exploring Wrecks of Sunken Ships

Emergency Marine Gangway

Captain Arthur N. McGray, of 119 West Seventy-first street, New York, has devised a scheme for the safe disembarking of passengers and crew from a ship in distress in a rough sea, which has the merit of being extremely simple to construct and handle. As shown by the illustration, it consists of an inclined gangway constructed of two booms with floats at the outboard ends to buoy them at the surface of the water. The booms are stayed by guy ropes and a wire net is spread between them over which, it is claimed, the passengers can safely pass. Sufficient slack is provided in the network at the outboard end so that the bow of the lifeboat can ride on the net. With a vessel in distress lying in the trough of the seas, the emer-

Emergency Gangway in Operation

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gency gangway would be lowered on the lee side, and by keeping the lifeboat bow-on to the rescue net the boat would be in the best possible position to ride the waves.

Plans for Government Steamer Surveyor

Preparations are being made by the Department of Commerce, Washington, D. C., for the reception of bids for the proposed new coast and geodetic survey steamer *Surveyor*. This vessel, of the ocean-going type, is to be used in surveying the work in Alaskan waters. Plans and specifications are now being prepared and will be ready by July 1. The vessel will be built along standard lines, and will be of a thoroughly serviceable type. Her equipment will also be of a standard type. This decision was reached in order that the construction of the boat should not be made unduly expensive by the use of special equipment. The *Surveyor* is to be 186 feet long, with a beam of 35 feet and a displacement of 1,000 tons. She is to burn crude oil and is to have a speed of 12 knots and a cruising radius of 8,000 miles. Accommodations will be provided for 11 officers and a crew of 56. Her wireless equipment will have a sending radius of 300 miles. The cost is not to exceed $220,000 (£45,000).

PERSONAL MENTION

Operating Engineers

John Clark, of New Orleans, La., has been appointed assistant engineer on the lake steamer *Hanover*.

M. J. Kennedy, of New Orleans, La., has been appointed assistant engineer on the ocean-going tug *Security*.

R. P. Petrie has been appointed chief engineer of the steamship *Isthmian*, which sailed recently for the Pacific Coast.

A. C. Thorsen, formerly chief engineer of the steamer *Honduras*, has been appointed chief engineer of the *Vigilancia*.

William Rigney, of New Orleans, La., has been appointed second assistant engineer of the steamer *Norman Bridge*.

Lorrain A. Horton is chief engineer of the sea-going yacht *Utawana*, owned by Commodore Armour of the New York Yacht Club.

J. T. Snow, chief engineer, and N. Morrison, first assistant engineer, have sailed on the steamship *Californian* for Buenos Aires.

H. F. Boardman, chief engineer, and J. F. Burke, first assistant engineer, have sailed on the steamer *Oregonian* for Rio de Janeiro.

Euler Brown has been appointed chief engineer of the steamer *Mohawk*, engaged in work on the New York State Barge Canal at Little Falls, N. Y.

W. H. Philbrook, formerly first assistant engineer of the steamer *Honduras*, has been appointed chief engineer of this vessel, succeeding A. C. Thorsen.

Charles Bortle has been appointed chief engineer of the twin-screw steamer *Julia Saffard* of the Albany & Troy Line, which went into service on May 30.

Sandy Andas, of Norfolk, Va., has been appointed assistant engineer of the steamer *St. Johns*, running on the Colonial Beach route from Washington, D. C.

Edward Fitzgerald, formerly chief engineer of the steamer *St. Johns*, has been appointed chief engineer of the *Dreamland*, running between Baltimore and Chesapeake Beach.

John F. McCoy has been appointed chief engineer of the steamer *Highlander*, which the McAllister Steamboat Company of New York has placed in the Hudson River excursion trade.

James Featherly, formerly an engineer in the Murray Line, has accepted a position as chief engineer of the tug *James H. Scott*, which went into commission on June 1, doing harbor work at Albany, N. Y.

George T. Cahill, secretary of the Marine Engineers' Beneficial Association No. 63, has been appointed chief engineer of the Federal Building at Albany, N. Y., having entered the Civil Service on June 1.

John Shultz, formerly first assistant engineer of the steamer *Coe F. Young*, has been transferred to the tug *Empire*, which is engaged in towing for the Great Lakes Dredge & Dock Company at Troy, N. Y.

John Houser, chief engineer of the towboat *George C. Adams* of the Cornell Towing Line, has been transferred to the steamer *Coe F. Young*. The *George C. Adams* has been laid up at Rondout, N. Y., for repairs.

Edward Washburn, formerly chief engineer of the Albany Carbonic Gas Works at Albany, N. Y., has been appointed chief engineer of the steam tug *Marguerite* of the Great Lakes Dredge & Dock Company.

Robert P. Cook, chief engineer of the Central Hudson Steamboat Company, with a record of fifty-three years of service on the Hudson river as a marine and superintending engineer, has retired from active service.

Frank D. Gatter, formerly chief engineer of the steamship *Portland*, which recently left San Francisco for Europe, has been appointed first assistant engineer of the steamship *Menoa* of the Matson Steamship Company.

Elsworth B. Mealy has been appointed chief engineer of the steamer *Florence W.*, which is engaged by the Vanderson Contracting Company in construction work on the New York State Barge Canal at Mechanicsville, N. Y.

George Butler, of Alexandria, Va., is chief engineer of the steamer *Pontonier*, which is owned by the United States Government for the use of the United States Engineer Corps. Captain Frank Lucket is in command of this vessel, succeeding Captain J. A. Beacham, resigned.

E. P. Evans is chief engineer and Joseph Nash assistant engineer of the tug *Mitchell M. Davis*, which has just been chartered by a Philadelphia firm and will probably be engaged on Delaware Bay during the summer. The tug is owned by the Taylor Bros., Washington, D. C., and commanded by Captain R. T. Fowks.

George Foss is chief engineer and Joseph Archer and William Stone assistant engineers of the steamer *Isis*, recently purchased by the Department of Commerce for coast and geodetic survey work. This vessel, under the

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command of Captain Paul Whitney, recently sailed from Washington, D. C., to take up the coast survey work.

William S. Werling is in charge of the engine room of the torpedo boat *Barney*, commanded by Lieutenant Loraine Anderson, which recently arrived in Washington, D. C., where she will remain for a period of about three months, during which time she will be engaged in giving the District of Columbia Naval Reserve practical experience in torpedo work and mine planting.

R. L. Brown is chief engineer and H. S. Johnson assistant engineer of the steam tug *Advance*, the most powerful tug of the fleet, owned by the Taylor Bros., Washington, D. C. This tug has been chartered by a New York firm and is under the command of Captain O. L. Crowder.

Dennis Ethridge, of Norfolk, Va., has been appointed chief engineer of the steamer *Wakefield*, with James Richardson of Washington, D. C., as his assistant.

Naval Architects, Consulting Engineers and Shipyard Officials

Rear Admiral Henry T. Mayo, U. S. N., has been selected for appointment as the first vice-admiral under the provisions of the naval act approved March 3, 1915.

At the commencement exercises of Columbia University, New York, the honorary degree of Doctor of Science was conferred upon Rear Admiral Robert Stanislaw Griffin, engineer-in-chief of the United States Navy.

Prof. Harold A. Everett, associate professor of naval architecture at the Massachusetts Institute of Technology, Boston, Mass., has resigned to take up the duties of professor of marine engineering in the Post Graduate Department of the United States Naval Academy, Annapolis, Md. Professor Everett graduated from the Massachusetts Institute of Technology in 1902 and since then has been continuously associated with the Institute as instructor, assistant professor and finally as associate professor of naval architecture. Professor Everett is the author of a number of papers on marine engineering subjects presented before the Society of Naval Architects and Marine Engineers and is well known to the readers of this magazine as the editor of the "Questions and Answers" department.

The Hawkins-Hamilton Company, Peoples National Bank Building, Lynchburg, Va., has been appointed as the representative of the Terry Steam Turbine Company, Hartford, Conn., for the State of Virginia.

J. Harry Mull, general superintendent of William Cramp & Sons Ship & Engine Building Company, Philadelphia, Pa., made the voyage to the Pacific Coast on the turbine steamship *Northern Pacific* when she was delivered to her owners.

Merton A. Pocock has been appointed district sales manager of the Terry Steam Turbine Company, Hartford, Conn., for the territory included in the States of Minnesota, North Dakota and South Dakota, with headquarters in the Endicott Building, St. Paul, Minn.

H. L. Ferguson, vice-president and general manager of the Newport News Shipbuilding & Dry Dock Company, Newport News, Va., recently announced the following changes in the officers of that company made since the death of President A. L. Hopkins, who was lost on the *Lusitania*: F. P. Palen, assistant general manager, is transferred to the New York office of the company. W. H. Benson has been appointed assistant to the general manager, and is transferred to the general manager's office. E. I. Cornbrooks is appointed superintendent of hull construction.

OBITUARY

John Samuel White, chairman of Messrs. J. Samuel White & Company, Ltd., the famous shipbuilding and engineering firm of East Cowes, died on May 14, aged seventy-seven years.

Thomas Johnson, former superintendent of the Harlan & Hollingsworth Company, Wilmington, Del., died at his home at Belle Haven, Va., on June 5, aged eighty-seven years. At the age of twenty-two he entered the employ of the Harlan & Hollingsworth Company as a helper in the boiler shop. From this position he rose to become superintendent of the shipyard. He retired in 1894, but two years ago he superintended the construction of two steamboats at Sparrows Point, Md.

S. Cornelius Midlam, formerly chief engineer of the Hudson River Day line steamer *Albany*, died at his home in New York city on June 2 at the age of eighty-four. Mr. Midlam retired two years ago, having served for twenty-seven years as chief engineer of the steamer *Albany*. At that time he was probably the oldest marine engineer in active service. Before entering the Hudson River Day Line service, Mr. Midlam had served in the United States Navy and during the Civil War was chief engineer of several war vessels.

Rear Admiral Benjamin F. Isherwood, U. S. N., retired, formerly engineer-in-chief of the United States Navy, died at his home in New York on June 19, at the age of ninety-two. Admiral Isherwood entered the navy in 1844 and served during the Mexican war and later with the Asiatic squadron. At the begnning of the Civil War he was appointed by President Lincoln chief of the newly organized Bureau of Steam Engineering and was intrusted with the work of building up a steam-driven navy. His work in this direction, bitterly attacked at the time, stands to-day as one of the most brilliant contributions to the development of steam engineering. In recognition of his achievements the steam engineering and naval construction building at the Naval Academy has been named Isherwood Hall and a bronze bust of the officer has been placed over the entrance bearing an inscription testifying "to his services to his country, to his profession and to his corps and to his international reputation in the science and art of engineering."

Among the engineers of the Cunard liner *Lusitania*, which was torpedoed off the Old Head of Kinsale on May 7, the following were lost: Archibold Bryce, chief engineer; W. T. Smith, intermediate second engineer; W. Hetherington, third senior third engineer; W. G. Fairhurst, first intermediate third engineer; W. H. Cole, second intermediate third engineer; T. R. Duncan, senior fourth engineer; R. E. Jones, Junior fourth engineer; W. A. Anderson, senior fifth engineer; S. C. Kelly, intermediate fifth engineer; J. H. Hayes, junior fifth engineer; J. Beggs, senior sixth engineer; D. Morrice, junior sixth engineer; J. Lee, senior seventh engineer; A. F. Wheelhouse, junior seventh engineer; J. F. Paton, steering engineer; C. S. Fenton, dock engineer; W. Quarrie, ventilating engineer; G. Latham, second electrician; R. Gould, first boiler maker; R. McLean, plumber.

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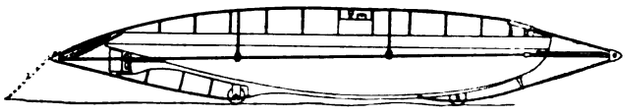
SELECTED MARINE PATENTS

The publication in this column of a patent specification does not necessarily imply editorial commendation.

American patents compiled by Derbert H. Decker, Esq., registered patent attorney, Millerton, N. Y.

1,135,537. SIMON LAKE, OF MILFORD, CONN., ASSIGNOR TO THE LAKE TORPEDO BOAT COMPANY OF MAINE, OF BRIDGEPORT, CONN., A CORPORATION OF MAINE.

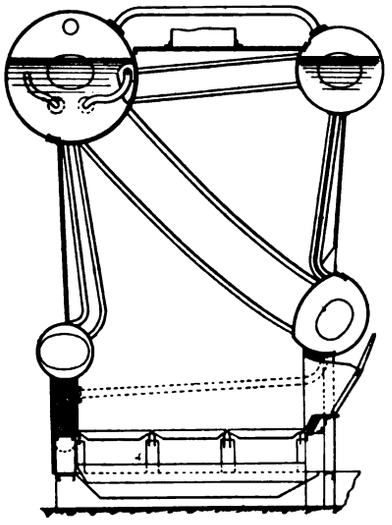
Claim 8.—The combination with a submarine boat, of combined steering and propelling wheels mounted in the boat and adapted to be projected below the keel thereof, a fender journaled in the sides of the bow of the boat, and comprising converging hollow arms having their



outer ends connected by a conical casting, means for controlling the position of said fender, fender rails extending from said fender over the deck, along the sides and under the keel of the boat, said rails having their after ends terminating aft of the stern of the boat, and antennæ connected to the casting of said fender, substantially as and for the purpose specified. Eighteen claims.

1,135,636. WATERTUBE MARINE BOILER. MARIO VALLINO, OF GENOA, ITALY, ASSIGNOR TO SOCIETA ANONIMA ITALIANA GIO. ANSALDO & CO., OF GENOA, ITALY.

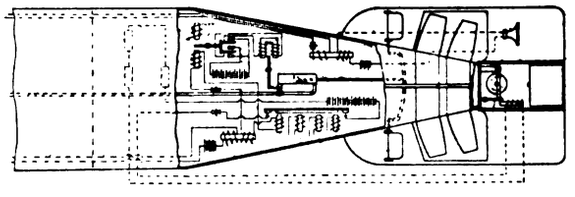
Claim 1.—In a watertube steam boiler of the type hereinbefore specified, the combination with a rear transverse upper steam and water drum, and a front transverse upper steam and water drum of connecting tubes exposed to the hot furnace gases, connecting the water space



of said rear upper drum with the water space of said front upper drum, a chamber in the water space of said rear upper drum inclosing the orifices of said connecting tubes, and feed water supply pipes for delivering into or outside the said chamber, whereby said connecting tubes are enabled to operate if desired, as the tubes of an economizer for heating the feed water before delivering same into said front upper drum.

1,137,222. TORPEDO AND OTHER SUBMARINE APPARATUS. KARL OSKAR LEON, OF GOTTENBORG, SWEDEN, ASSIGNOR TO LEON STEERING DEVICE COMPANY, OF BROOKLYN, N. Y., A CORPORATION OF NEW YORK.

Claim 8.—The combination with a submarine vessel of a pair of receivers adapted to be actuated by like vibrations of the water, a steering

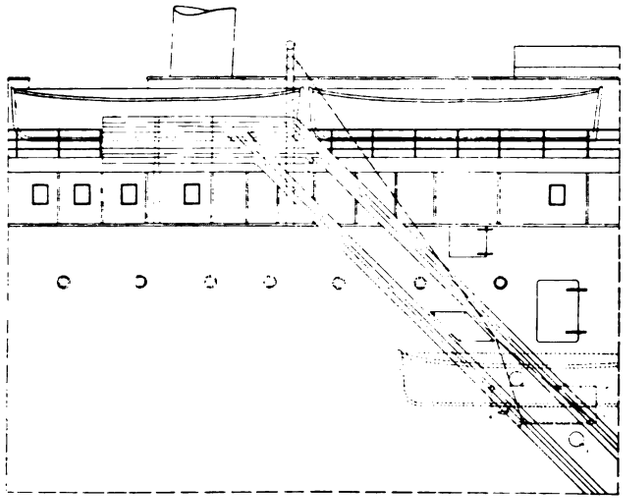


device for the said vessel, controlling means for the said steering device, electric circuits each including one of the said receivers, transformers each having a primary winding included in one of the said circuits, electromagnets each connected in circuit with the secondary winding of one transformer, and means operated by the said electromagnets for actuating the controlling means to steer in one or the other direction toward the source of such vibrations, according as one or the other electromagnet is energized. Fourteen claims.

British patents compiled by G. F. Redfern & Company, chartered patent agents and engineers, 15 South street, Finsbury, E. C., and 10 Gray's Inn Place, W. C., London.

26,523/1913. IMPROVEMENTS IN AND RELATING TO STOWAGE, DECK TRANSPORT AND LAUNCHING OF SHIPS' BOATS. CAPT. W. P. THOMPSON, 44, PARKFIELD ROAD, AIGBURTH, LIVERPOOL, AND L. ADDISON AND S. J. CAREY.

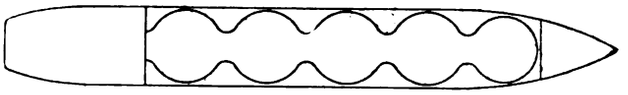
The invention relates to improvements in the stowage, deck transport and launching of ships' boats. Broadly, one primary feature of the invention consists in lowering boats down rails or other equivalent devices lying substantially in the plane of the ship's side, while supporting the boat bracket-wise on rails. The bogies are run along the deck rails so that their side wheels engage with a pivoted gangway. This is then



rotated to bring the boat with bogey into the overside position. The boat is then pulled by means of a davit or the like on to rails which extend down to the water. Where these rails are oblique or vertical it is preferable that they should run for some distance in a horizontal direction before turning downwards. After the boat has become waterborne and floated clear of bogey, the latter may be again raised, if necessary, either by way of the launching rail or a special return rail.

2,936/1915. IMPROVEMENTS IN OR RELATING TO SHIPS. J. J. BITTLESTONE, 11, LAURA STREET AND H. T. JOHNSON, BOTH IN SUNDERLAND.

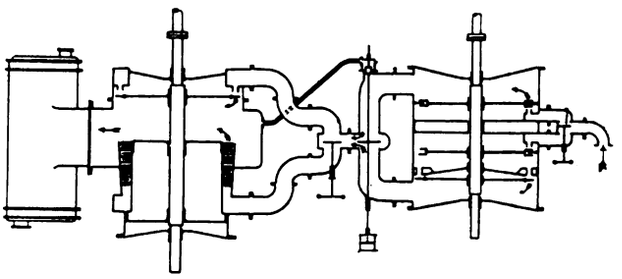
According to the invention the ship is provided with an inner skin at each side composed of continuous plating forming a series of alter-



nate bulges and recesses, the inner skin at one side of the vessel being independent of that at the other side throughout its length. The inner skin will tend to safeguard the vessel from flooding in the case of collision or damage.

5,870/1914. IMPROVEMENTS IN OR RELATING TO TURBINE INSTALLATIONS FOR MARINE PROPULSION. K. ALQUIST, 147, CLIFTON ROAD, RUGBY.

The object of the invention is to effect a saving in weight and cost of the machinery by running the turbines in series, thereby reducing the total number of bucket rings required for a certain efficiency, while at the same time preserving the independence in operation of each propeller shaft. The principle on which this object is obtained consists



broadly in so arranging the admission valves of the turbine units that each propeller may be run forward, stopped, or reversed without interrupting the flow through the turbines. The invention is illustrated in the drawing, which is a diagram of an application suitable for two propeller shafts. One shaft is driven by a high-pressure turbine dealing with about 50 percent of the total steam energy, approximately utilizing the steam from boiler pressure down to atmospheric pressure in the case of ordinary operating conditions, and the other shaft is driven by a low-pressure turbine utilizing the remaining steam energy down to condenser pressure. Both turbine units are provided with forward elements and reversing elements.

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